DOCUMENT RESUME

ED 035 733 VT 009 942

AUTHOR	Williams, William A.
TITLE	An Accident Prevention Program for School Shops and Laboratories; A Suggested Guide for School Administrators.
INSTITUTION	National Safety Council, Chicago, Ill.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C.
PUB DATE	[66]
NOTE	254p.
AVAILABLE FROM	National Safety Council, 425 North Michigan Avenue, Chicago, Illinois 60611 ($6.50)
EDRS PRICE	EDRS Price MF-$1.00 HC-$12.80
DESCRIPTORS	*Accident Prevention, Bibliographies, Guidelines, Industrial Arts, Laboratory Manuals, *Laboratory Safety, National Organizations, *Resource Guides, *Safety Education, *School Safety, School Shops
IDENTIFIERS	*National Safety Council

ABSTRACT

Effective and realistic planning and improvement of the educational environment can prevent accidents and injuries in school shops and laboratories. This guide makes specific recommendations for organizing and administering such a program and suggests methods and techniques for implementing the recommendations. Chapters cover organizing, administering, and implementing an accident prevention program, education and training for accident prevention, and a bibliography of books, pamphlets, booklets, periodical articles, unpublished materials, visual aids, posters and charts, and catalogs and directories. Appended are (1) State Level--Master Plan Format for Accident Prevention in School Shops and Laboratories, (2) Local Level--Master Plan Format for Accident Prevention in School Shops and Laboratories, (3) An Outline for a School Shop Safety Program, (4) Acknowledgement of Safety Instruction and Pledge, (5) Sources of Helpful National Organizations, (6) Model School Eye Safety Law, (7) Job Safety Analysis--Work Sheet, and (8) National Standard School Shop Safety Inspection List. (GR)

ED035733

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

an accident prevention program *for* school shops and laboratories

A SUGGESTED GUIDE FOR SCHOOL ADMINISTRATORS

By William A. Williams, Ph. D., Professor of Industrial Education,
Department of Vocational Education, The Pennsylvania State University

Developed Pursuant to a Contract With the Office of Education
U.S. Department of Health, Education, and Welfare

Published by NATIONAL SAFETY COUNCIL • 425 North Michigan Avenue • Chicago, Illinois 60611

FOREWORD

The first President's Conference on Industrial Safety held in March of 1949 proposed the development of an adequate program of industrial safety at the secondary school level. This recommendation was reaffirmed by the 1958, 1960, 1962, and 1964 President's Conferences on Occupational Safety.

In 1963 the American Vocational Association, by resolution, called on the U.S. Office of Education to provide leadership and material assistance on the previously indicated recommendations. The School and College Conferences of the National Safety Council in October 1964 gave official support to the American Vocational Association resolution.

The latest official action by an education group was taken by an *ad hoc* committee appointed by the U.S. Commissioner of Education and is contained in a report of that committee. Specifically, the report says that the Division of Vocational and Technical Education, Office of Education, should develop or contract to develop, the necessary plans and materials required for a comprehensive program of school shop and laboratory safety education that can be made available to all education institutions and schools of the nation.

A national committee consisting of educators, and industry, and government representatives served in a consulting capacity in the development and review of the content. The efforts and assistance of the committee members greatly enhanced the technical excellence of the guide and made its publication possible; they are as follows:

Clair F. Fitz
Senior Area Coordinator
Department of Vocational Education
The Pennsylvania State University
University Park, Pennsylvania

Wayne P. Hughes, Director
School and College Department
National Safety Council
Chicago, Illinois

Clyde Smith, Chief
Branch of Youth Standards
Bureau of Labor Standards
U.S. Department of Labor
Washington, D.C.

Jack Duvall, Supervisor
Vocational Education
Detroit Public Schools
Detroit, Michigan

Earl Bowler, Assistant Director
Program Services Branch
Division of Vocational and
Technical Education
U.S. Office of Education
Washington, D.C.

Denis J. Kigin
Associate Professor
Department of Industrial Education
University of Missouri
Columbia, Missouri

Ernest Levens
Corporate Director of Safety
Douglas Aircraft Company, Inc.
Santa Monica, California

This Guide was prepared by the Pennsylvania State University under a contract with the U.S. Office of Education. Dr. William A. Williams, Professor of Industrial Education at the Pennsylvania State University, an expert in the field and author of other related safety publications, planned and prepared the manuscript.

Walter M. Arnold
Assistant Commissioner for
Vocational and Technical Education

CONTENTS

Chapter Page

1 INTRODUCTION 1

Purpose of the Guide 1

Nature and Magnitude of the Problem 4

Solutions to the Problem 13

Overview of the Guide 24

References 28

2 ORGANIZING FOR ACCIDENT PREVENTION 29

Principles of Organization for Accident Prevention 30

Organizational Structure 34

Steps in Organizing the Program 40

Policies 43

Responsibility 45

The Safety Committee 48

Cooperating Agencies 51

References 53

3 ADMINISTERING THE ACCIDENT PREVENTION PROGRAM 54

Principles of Administration 54

Exercise of Authority 64

Motives and Incentives 69

Documentation 73

References 78

Chapter Page

4 IMPLEMENTING THE ACCIDENT PREVENTION PROGRAM 79

Preferred Safety Practices for Shop Teachers 80

Safety Standards 87

Hazard Analysis 93

Safe Use of Instructional Equipment and Materials 97

Facility Design and Layout 99

Manual Handling and Storage of Materials and Tools 105

Machine Guarding 108

Maintenance for Safety 113

Fire Prevention and Extinguishment 116

Electrical Hazards 121

Housekeeping 126

Health Hazards 129

Personal Protective Equipment 134

Emergency Action Plans 142

Inspections 147

Accident Reporting and Analysis 152

References 163

5 EDUCATION AND TRAINING FOR ACCIDENT PREVENTION 165

Safety Education 165

Safety Training 166

The Industrial Teacher-Educator Contributes to Safety Education 167

A Teacher Education Program 170

Safety Education for Administrators and Supervisors 172

Chapter Page

5 EDUCATION AND TRAINING FOR ACCIDENT PREVENTION (cont.)

Safety Education and Training of Students 175

References 179

BIBLIOGRAPHY 180

Books 181

Pamphlets, Booklets, Magazines 183

Periodical Articles 194

Unpublished Materials 202

Visual Aids 206

Posters and Charts 213

Catalogs and Directories 213

APPENDIXES 215

A. A Master Plan Format for Accident Prevention in School Shops and Laboratories–State Level 216

B. A Master Plan Format for Accident Prevention in School Shops and Laboratories–Local Level 220

C. An Outline for a School Shop Safety Program 225

D. Acknowledgement of Safety Instruction and Pledge 232

E. Sources of Help–National Organizations 233

F. Model School Eye Safety Law 236

G. Job Safety Analysis–Work Sheet 238

H. National Standard School Shop Safety Inspection List 240

CHAPTER 1

INTRODUCTION

The first objective of an accident prevention program in school shops and laboratories is immediate and urgent—to prevent accidents which might result in injury or harm to students, teachers, other school personnel or visitors, damage to facilities and equipment, or interruption of the educational processes. We live in an era of technological change and development, characterized by new hazards growing out of new concepts and techniques, new power sources, new materials, and new industrial processes. Consequently, there is a particularly significant need for safety, and the educational programs of our schools must reflect our concern for accident prevention.

When state and local school administrators undertake the obligation of providing shop and laboratory experiences for youths and adults enrolled in their schools, they accept the responsibility of striving for an accident-free environment and a program of instruction which will include emphasis on effective safety practices. The brunt of this responsibility is, of course, delegated to the teacher, but effective fulfillment of the teacher's responsibility can be accomplished only with the active support and cooperation of administrative and supervisory staffs. Public education should recognize the importance of safety education and follow the lead taken by industry and business in adopting a positive approach to the problem of accident prevention. School shops and laboratories which include safety instruction as an integral part of their curriculum will, as a result, have made an important contribution to our nation's program of occupational safety while protecting students, teachers, and facilities.

Safety concepts and safe practices grow equally from an understanding of the factors that contribute to accidents and from the performance of tasks in a safe environment. School shops and laboratories provide an environment for the development of safety concepts and safe habits that will guide the actions of the individual throughout his life. Assuming that it is true that behavior patterns are formed in part from experiences and environmental background, then school shops and laboratories have an important role in developing sound concepts and attitudes pertaining to occupational safety.

Purpose of the Guide

This Guide's purpose is to assist state and local school administrators and teachers in their efforts to prevent accidents and injuries in school shops and laboratories through effective and realistic planning and improvement of the educational environment. This Guide will make specific recommendations for organizing and administering such a program and will suggest methods and techniques for implementing the recommendations. Principles and practices for education and training for accident prevention will also be included. However, the Guide is not a prescription for safety; the continued interest, intelligence and educational skills of school administrators and teachers are essential in applying the principles discussed here.

Accident prevention is profitable. Some of the benefits are immediate, some are intermediate, and some are long range.

Immediate Benefits

1. Injuries to students will be reduced in number and severity.
2. Students will learn safe practices and procedures.
3. Students will have teachers who have a sincere interest in accident prevention.
4. School principals will receive suggestions for providing and maintaining a safe school environment.
5. Teachers will have a safe environment in which to teach and work.
6. Personnel will move about the school environment in a safe efficient manner.
7. Those in authority will set a good example for students.
8. Administrators will provide the effective leadership required in all accident prevention activities.
9. Administrators will designate qualified personnel of their staffs to direct and supervise accident prevention program activities.
10. Administrators will provide for an organizational structure which will insure an effective accident prevention effort.
11. Administrators will establish the necessary administrative details required to manage an accident prevention program.
12. Administrators will establish policies consistent with the needs of the accident prevention program.
13. Financial resources of the school will be conserved by preventing damage to property and equipment.

Intermediate Benefits

1. Accident frequency and severity will be reduced.
2. Students will develop good safety attitudes through actual training and practice of safe living in their shops and laboratories.
3. Students will know and realize that good safety attitudes are required of them when they accept a job in business and industry.
4. Teachers will be provided with the opportunities to learn the methodology of safety education.

5. Safety specialists will receive the needed cooperation from other personnel to accomplish the objectives of the accident prevention program.

6. Safety specialists will receive support for their recommendations from school administrators.

7. School principals will receive guidance on safety policies and procedures.

8. School principals will receive assistance in solving special problems affecting the safety of personnel in their schools.

9. Administrators will recognize that accident prevention is a responsibility which must be accepted.

10. Administrators will become aware of the total aspects of an accident prevention program.

11. Students will develop the ability to evaluate potential hazards in activities which may form a part of their future careers, and to take the appropriate accident prevention measures.

12. Students will already have a record of accident-free performance when they accept a job outside of the school environment.

Long-range Benefits

1. Students will develop appropriate safety attitudes and judgments.

2. Students will develop a safety consciousness which they can take into their field of employment.

3. Students will develop the ability to discriminate between worthwhile and undesirable risks and act accordingly.

4. Students will learn self-discipline and be taught to understand and live with authority.

5. Students will be prepared to cope with the obvious and presumed hazards both in and out of school.

6. The influence on the student of a safe school environment and adequate safety instruction will carry over into out-of-school environments.

7. Business and industry will be assured that the product of the schools who come to them for employment has been prepared in the basic fundamentals of safety.

8. Public tax money will be conserved through effective accident prevention programming.

Nature and Magnitude of the Problem

A presentation of the nature and magnitude of the problem of accidents in school shops and laboratories is demonstrated by the statistics available from three representative sources–Detroit Public Schools, The National Safety Council, and the U.S. Department of Labor. The moral, social, and legal aspects of accident prevention are discussed later in this section.

Reference is also made to the Ohio State Industrial Commission's study of the school shop accident situation in the state. In addition to providing information on the specifics of the accident situation in Ohio, this program is of special significance to state departments of education who might be interested in developing similar programs in their states.

Detroit Public Schools Data

The Detroit Public Schools system maintains through its Department of Safety Education an accident reporting program to determine the frequency of student accidents occurring in school buildings, on school ground, between school and home, at home, and on field trips. The system has four objectives:

1. **Prevention**, to indicate areas that need correction;
2. **Defense**, to contain precise facts regarding negligence and liablility;
3. **Protection**, in case of law suits;
4. **Constructiveness**, to be used as a guide for curriculum planning.

A summary report[1] issued by the Department of Safety Education in October, 1965 indicates that a total of 6,771 accidents involving students occurred during the period from July 1, 1964, through June 30, 1965. A breakdown of these totals by location and type and in order of frequency during 1963-64 and 1964-65 is as follows:

	1963-64	1964-65
1. Health Education	2,133	2,651
2. Other classrooms	1,096	1,275
3. Playground	770	670
4. Vocational (and industrial arts)	417	600
5. Between school and home (including traffic accidents)	684	456
6. Corridors and doors	385	401
7. Stairs	196	208
8. At home and elsewhere	292	165

9. Lavatories	145	158
10. Cafeteria	43	86
11. Art	70	57
12. Science, etc.	95	46
13. Trips and excursions; driver education	8	20

These figures reveal that approximately 23 per cent of the accidents occurred in the vocational and industrial arts shop areas. Of the total of 600 accidents in the department of vocational education, 503 accidents occurred in the industrial education shops and 97 in the homemaking laboratories. The accidents in the vocational and industrial arts education shops were reported as follows: special education 23; elementary education, 55; junior high schools, 187; senior high schools, 125; and trade and, technical schools, 113. The accidents in the homemaking laboratories were reported as follows: special education, 6; elementary education, 28; junior high schools, 34; senior high schools, 28; and trade and technical schools, 1.

The report further reveals that in the industrial education shops, sharp metal, scroll saws, flying objects, falling objects, knives, cuts, engine lathes, horseplay, falling and fighting were the greatest causes of accidents. In the homemaking laboratories, needles, hot pans, knives, sewing machines, and scissors were the greatest causes of accidents.

National Safety Council Data

For several years, *Accident Facts,*[2] a publication of the National Safety Council, has summarized school jurisdiction accidents which occurred during the reported year–accidents which required a doctor's attention or causing one-half day's absence or more. The figures below are representative of the number of accidents, per 100,000 student days, which occur to boys and girls in the listed shop and laboratories.

Homemaking	0.06
Science	.09
Vocational, industrial arts	.58
Agricultural	.02
Other laboratories	.03
Other shops	.09
	0.87

U.S. Department of Labor Data

In an effort to compile information on the occurrence of work injuries and to improve the effectiveness of accident prevention efforts for young workers, the Bureau of Labor Standards of the U.S. Department of Labor, in cooperation with 28 states, has completed a study[3] of work injuries to minors under 18 years of age occurring during the 18-month period from January 1964 through June 1965. Participating states were Alabama, Arkansas, California, Connecticut, Delaware, Florida, Idaho, Illinois, Indiana, Kansas, Kentucky, Maryland, Michigan, Minnesota, Montana, Nebraska, Nevada, New Jersey, New Mexico, North Dakota, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Utah, Wisconsin, and Wyoming. This information is also of considerable value to educators as an indication of the types of accidents and injuries their students are likely to be subjected to when they enter the industrial environment.

This study shows:

- A total of 16,936 injuries to employed minors under 18 was reported by 28 states.
- Many of these injuries were serious, resulting in fatalities, amputations, loss of use of body parts, strains, hernias, crushed body parts, burns, and fractures.
- Based on the activity in which the worker was engaged at the time of injury, manual handling of materials and equipment resulted in the greatest number of injuries. This was followed by servicing activities (oiling equipment and machinery, servicing cars, adjusting equipment, etc.); using hand tools; cleaning, washing, and clearing; and operating power-driven machines.
- The largest number of injuries reported occured in the wholesale and retail trade, services, and manufacturing. Agriculture and contract construction ranked fourth and fifth, respectively.
- The serious nature of injuries occurring in the various industries is indicated in this report. Food and kindred products showed a sizable proportion of injuries resulting in amputations, while strains, sprains, and hernias were high in hotels and lodging places. Crushing injuries appeared to be similarly represented in all industries. Burns and scalds occurred often in eating and drinking places and in gasoline service stations. Fractures were frequently reported in all industrial classifications.
- Machines, working surfaces (floors, stairs, roads, etc.), containers (boxes, crates, cartons, etc.) vehicles, and hot substances were the leading sources in the majority of the injuries of a more serious nature reported. Hand tools, although typically not resulting in serious injuries, accounted for a large number of the reported cases.
- The leading accident type was that in which the injured person was struck by or against an object. The second most common type was falls. The third was that in which the worker was caught in, under, or between objects. Overexertion accounted for a high percentage of all reported injuries.

- The large number of back strains emphasizes the importance of proper instruction in lifting, carrying, and handling materials.

- Amputations, fractures, crushing injuries, and burns and scalds were primarily to hands, fingers, feet, and toes.

The report did not establish injury-frequency and severity rates nor did it make comparisons with the work-injury experience of adults. Lack of information on work exposure in specific industries or occupations precluded statistical evaluation of the relative significance of any injury component treated. Comparison of injury occurrence on an industry-to-industry basis was not made because of variations in classification methods and injury-reporting requirements in the individual states. Comparison of one state's experience with that of another was not made because of variations in child-labor laws and regulations and differences in state injury-reporting requirements. For the reasons stated, the total of 16,936 injuries reported should not be considered either as a national total or as the actual total number of injuries occurring in the participating states.

Injury Occurrence

The total number of injuries reported in the major industrial classifications appears in Table 1. Of the total, more than 60 per cent occurred in the wholesale and retail trade and services industries. However, large numbers of injuries were reported in each of the other classifications as well. Caution should be used in interpreting the rankings indicated because of the limited nature of the available statistics. For example, the conclusion that the wholesale and retail trades are more hazardous than agriculture may not be justified, since the total exposure is not indicated.

Nature of Injuries

Most injuries were cuts, abrasions, punctures, bites, etc., but many strains, sprains, hernias, etc., and other kinds of more serious injuries were also reported.

	Per cent
Cuts, abrasions, punctures, bites, etc.	42.9
Bruises and contusions	14.0
Strains, sprains, hernias, etc.	13.7
Burns and scalds	8.6
Fractures	7.0
Occupational diseases and poisings	1.6
Crushing injuries	1.3
Amputations or loss of use of body part	1.0
Others and unknown	9.9

With regard to serious injuries, amputations, loss and use of body parts accounted for only 1 per cent of injuries reported from all industries combined, but were more than 3 per cent of all injuries for workers in lumber, wood products, and furniture and over 2 per cent of those in food and related products. Strains, sprains, and hernias comprised more than 19 per cent of the occupational injuries in hotels and lodging places. Injuries of this type were also high in personal services, in transportation, communications, related industries, and in contract construction, agriculture, and manufacturing.

TABLE 1*

REPORTED INJURIES OCCURRING TO MINORS UNDER 18 YEARS OF AGE BY MAJOR INDUSTRY*
28 STATES: JANUARY 1964-JUNE 1965

Industry	Number	Per cent
TOTAL	16,936	100.00
Agriculture	1,849	10.9
Contract construction	1,240	7.3
Manufacturing	2,550	15.1
Wholesale and retail trade	7,631	45.1
Services	2,613	15.4
Miscellaneous†	1,053	6.2

* Comparisons between industries are not valid because of variations in state industry classification methods, differences in reporting coverage, and diversity in child-labor laws and regulations.

† Includes mining, transportation, finance, government, and unclassified industries.

Crushing injuries accounted for slightly more than 1 per cent of the injuries in all industries combined, but were 2 per cent and above in agriculture, manufacturing, wholesale trade, and the transportation, communications, etc., industry. However, lumber wood products and furniture manufacturing with 4.6 per cent crushing injuries had a considerably higher percentage than the other classifications.

Certain activities seem to result in higher percentages of particular types of injuries. For example, 28.7 per cent of the injuries suffered by workers engaged in manual handling were strains, sprains, and hernias, etc., with an even higher percentage of cuts, abrasions, punctures, bites, etc., occurring for this type of activity. Strains, sprains, hernias, etc., also represented a large percentage of the injuries received while the worker was climbing or walking. There is also a high percentage of bruises and contusions among the total injuries resulting from the above activities.

The study also contained details on the part of the body which sustained injury. Of the total reported number of amputations, loss, and use of a body part, 126 were finger injuries. The largest per cent of strains, sprains, hernias, etc., were trunk injuries–1,086, of which 761 were to the back. Most of the 1,193 fractures were confined to the upper and lower extremities.

Accident Types

The types of accidental injuries reported in this study include the following:

	Per cent
Struck by or against moving or stationary objects	46.4
Falls from elevation or on the same level	13.1
Caught in, under, or between moving or stationary objects	9.8
Over-exertion	6.9
Contact with temperature extremes	5.8
Motor vehicle accidents	2.4
Contacts with caustics, poisons, radiation, etc.	2.3
Rubs, abrasions	2.2
Body reaction	1.4
Others and unknown	9.8

The statistics indicate that the great majority of accidental injuries are caused by the worker being struck by or against an object. By industry, the percentages for this type of accident are as follows: retail trade, 52 per cent; contract construction, 46.4 per cent; wholesale trade, 45.6 per cent; and services, 43.9 per cent.

Machine Injuries

Injuries of a potentially serious nature involving the use of machines were frequently reported in this study. Cuts comprised the largest number of machine injuries. Two machines, saws and meat slicers, were the chief sources of these injuries. Following is a breakdown of 1651 injuries known to have been caused by a particular type of machine:

Agitators	49
Buffers	52
Meat grinders	53
Lawn mowers	60
Saws	109
Meat slicers	381
Other machines	328
Machines not elsewhere classified	619
Total	1651

Case Stories

The following examples, extracted from the study, are illustrative of the reported fatalities and injuries.

- A fifteen-year-old was fatally shocked while doing maintenance work when a pipe he was moving touched a high-voltage wire.
- The hand of a sixteen-year-old ranch worker was caught in a baler and crushed.
- A sixteen-year-old laborer was unloading a hoist platform on an upper floor when he fell and was crushed under the descending platform.
- A metal worker, aged 16, employed by a heating and air conditioning firm, lost the middle finger of his right hand when he slid his hand under the guard blade of a squaring shear.
- A box manufacturing firm employee, a seventeen-year-old male, had his finger amputated when it was caught between the roll and the cylinder of a corrugating machine.
- While showing another employee how to use the cutting machine, a seventeen-year-old girl, employed as a cutter by a manufacturer of children's wear, lost a finger of her right hand.

- A sixteen-year-old helper employed by a refuse collection firm suffered amputation of thumb when it was caught in a container.

- A truck driven by a seventeen-year-old employee was in an accident, which resulted in the amputation of one of the driver's legs.

- While lighting a cutting torch, a scrap yard worker, a fourteen-year-old boy, received fatal burns as a result of a flash-back.

- A fifteen-year-old employee of a wholesale grocery firm lost a finger when it was caught in a meat grinder that he was operating.

- A sixteen-year-old employed in an eating and drinking establishment was fatally injured when he fell against a knife.

- A seventeen-year-old employed in a retail establishment had two fingers amputated by an ice machine which he was operating.

- A newsboy, aged 14, died of injuries sustained when he was struck from behind by a car while he was riding his bicycle.

- A hospital employee, a seventeen-year-old female kitchen helper, had a finger amputated in a laundry machine.

- A member of the Youth Corps amputated a toe with an ax he was using.

Conclusions and Recommendations

The data show that a large number of minors suffer injuries during the course of their employment in all industries. The number of amputations, strains, sprains, hernias, crushing injuries, and fractures indicates the serious nature of the problem of industrial safety and the important need for systematic nationwide reporting of injuries to minors in order to have more complete data from which to work.

With the information contained in the report as a basis, and on other data available on youth employment, it was recommended that the following actions be taken to minimize injuries to employed minors:

1. Broaden and intensify occupational safety training in schools, youth serving institutions, work experience programs, and in all other educational settings.

2. Conduct on-the-job safety training as early as possible, particularly in the areas of lifting, manual materials handling, housekeeping, use of hand tools, and in helping youth to realize that their physical abilities have limitations.

3. Provide the type of supervision that will gain the respect of the young worker and at the same time set a safety example.

4. Provide personal protective equipment (such as for the eyes, feet, and hands) and require its use where needed.

5. Stress sound safety practices in the use and servicing of machines, especially saws, meat slicers, meat grinders, and similar machines.

6. Evaluate, update, and improve existing hazardous-occupation prohibitions to insure that they afford sufficient protection to employed minors.

7. Develop and tailor safety educational materials to the interests of youth.

Moral, Social, and Legal Aspects

In 1949, the Board of Directors of the National Safety Council declared in a formal statement of policy: "The elimination of accidents is vital to the public interest. Accidents produce economic and social loss, impair individual and group productivity, cause inefficiency and retard the advancement of standards of living." The Council in its *Accident Preventation Manual for Industrial Operations*[4] emphasizes that

> On the practical side there is a simple and obvious fact that accidents cripple industry and society. On the moral side there are two related premises: the first that needless destruction of human life is of itself evil; the second that failure to take precautions against predictable accidents involves serious guilt. These two aspects of the industrial accident problem, the practical and the moral, are not easily separated, for waste is a moral failure and sound morality finds expression in practical realities.

The Council, in summarizing the reasons for continuing a militant effort to prevent accidents, concludes that:

1. Needless destruction of life and health is a moral evil.

2. Failure to take necessary precautions against predictable accidents involves moral responsibility for those accidents.

3. Accidents are destructive of efficiency and productivity.

4. Accidents produce far-reaching social harm.

5. The safety movement has already demonstrated that its techniques are effective in reducing accident rates and promoting efficiency.

6. Nothing in the available data suggests that safety people are anywhere near a limit in their ability to extend the moral and practical values of accident prevention.

7. Safety personnel have available a tremendous body of knowledge, an effective nationwide safety organization, an enhanced prestige, great economic resources, and a sound basis for confidence in their methods.

Legal Aspects

Denis J. Kigin[5] emphasizes the legal aspects of school-related accidents in the following statement:

> The prevention of pupil injuries in the school shop has assumed major educational and humanitarian significance and is acknowledged as the primary function of a school shop safety program. The responsibility for providing a safe environment in which pupils may work and learn is shared by the teacher in the school district. It is the responsibility of the school district to furnish adequate facilities and the responsibility of the teacher to see that these facilities are utilized and properly maintained. It is accepted that teachers are not insurers of the safety of the pupils but they do accept a degree of responsibility because of the nature of their position. In addition to these more obvious issues, pupil injuries have the potential to involve the individual teacher and/or the school district in legal action. A complicated and complex situation can develop when suit is brought in an attempt to recover damages resulting from such an injury. It is understandable that parents might seek damages for a pupil injury as financial aggrievement and physical harm can in themselves constitute valid reasons for legal action. These facts serve to illustrate that shop teachers and school administrators should not only be concerned with the physical well-being of pupils but should also be made cognizant of the grave legal consequences which may stem either directly or indirectly from a pupil injury. Reduction of the possibility of legal involvement has therefore been recognized as a secondary function of a safety program.

Solutions to the Problems

The term "accident prevention program" refers to the systematic planning which takes place before a task is undertaken to insure that it may be performed without personal injury or property damage. Public education should recognize the importance of safety education and follow the lead taken by industry and business in adopting a positive approach to the problem of accident prevention.

The Accident Sequence

One of the nation's leading exponents of the scientific approach to accident prevention was H.W. Heinrich, formerly of the Engineering and Loss Control Division of the Traveler's Insurance Company. His approach to the accident sequence is effectively described in his accident prevention text.[6] He says:

> A preventable accident is one of the five factors in a sequence that results in an injury. The injury is invariably caused by an accident and the accident in turn is always the result of the factor which immediately preceded it. In accident prevention the bull's eye of the target is in the middle of the sequence–an unsafe act of a person, and/or a mechanical or physical hazard. The several factors in the accident occurrence series are given in chronological order in the following list:

1. Ancestry and social environment.

2. Fault of person.

3. Unsafe act and/or mechanical or physical hazard.

4. Accident.

5. Injury.

The occurence of a preventable injury is the natural culmination of a series of events or circumstances which invariably occur in a fixed and logical order. One is dependent on another and one follows because of another, thus constituting a sequence that one follows because of another, thus constituting a sequence that may be compared to a row of dominoes placed on end and in such alignment in relation to one another that the fall of the first domino precipitates the fall of the entire row. An accident is merely one factor in the sequence.

Safety education can thus be considered as being directed to the interruption of this series of events by knowledge of the techniques for the elimination of the central factor–the unsafe and/or mechanical or physical hazard. The scientific approach identifies these accident causes and then attempts to eliminate them through the application of appropriate behavioral or environmental controls. The basic working concept is that ALL ACCIDENTS ARE PREVENTABLE.

Ancestry and Social Environment

Psychologists state that certain human characteristics can be inherited; often these inherited characteristics play important parts in accidents. Some of the more obvious cases in which inherited characteristics may be factors in accidents are poor eyesight, bad hearing, and some nervous tendencies. Many cultural characteristics passed on from parents to children may also be brought to the accident situation. Among these are recklessness, stubbornness, avarice, and other undesirable traits of character. In many cases these inherited and cultural characteristics of the individual are very important elements to consider in accident prevention.

Each person brings to the accident situation the total results of his contact with the environment over his entire life span, including habits which he may have formed in childhood. Some of these behavior patterns may cause the individual to be susceptible to particular types of accidents under certain conditions. These are known as unsafe behavior patterns. Unsafe attitudes, demonstrated by showing off and recklessness, have their origin in the environmental background of the individual.

It is important to recognize that both heredity and environment contribute to behavior and consequently to the factor given as "fault of person." In some cases the hereditary factors can be compensated by appropriate selective placement of the individual. The environmental factors, however, are more amenable to modification through the educational process.

Fault of Person

There are numerous factors–environmental, physical, mental, and psychological–which may cause some person, even though not the injured party, to be at fault and responsible for an accident. The lack of knowledge or skill is, of course, one of these factors, as is physical unsuitability. Physical factors which can influence a worker's performance include age, weight, height, hearing, eyesight, muscle tone, reaction time, illness, allergies, fatigue, nervousness, intoxication, and physical handicaps in general. Manifestations of improper attitudes which can lead to accidents include willful disregard for danger, resentment of authority, inattention to instructions, indifference, overconfidence, absentmindedness, intolerance, undue haste, distraction, anger, impertinence, playfulness, boredom, laziness, excitability, and nervousness.

Personal factors which lead to unsafe acts and/or mechanical or physical hazards may show up in the work situation **through the fault of the managerial and supervisory staff, as in the following examples:**[7]

1. Lack of organized safety procedures, including plant safety inspectors, committees, accident investigation, and forms.
2. Inadequate or ineffective safety work.
3. Lack of executive direction of and participation in safety work.
4. Failure to guard machines and to provide adequate light, ventilation, first aid, hospital and sanitary facilities, personal protection, safe tools, and safe working environment in general.
5. Lack of suitable procedures for examining new employees for physical fitness and work experience.
6. Lack of suitable procedures for assignment of employees to work that they can do safely.
7. Poor morale of employees.
8. Lack of suitable training and instruction of employees in safety and of supervisors in the art of supervision.
9. Lack of enforcement of safe practice rules.
10. Failure to determine responsibility for accident occurrence.

Unsafe Act

The National Safety Council defines an unsafe act as "a violation of a commonly accepted safe procedure "[8] Such acts are usually classified under the following general headings:

1. Operating without authority; failure to secure or warn.
2. Operating or working at unsafe speeds (too slow, too fast, and throwing materials).
3. Making safety devices inoperative (removing, misadjusting, and disconnecting).
4. Using unsafe equipment; using hands instead of equipment; or using equipment unsafely (unsafe loading, placing, mixing, and combining).
5. Taking unsafe position or posture (standing or working under suspended loads, and lifting with back bent).
6. Working on moving or dangerous equipment (cleaning, adjusting, and oiling).
7. Distracting, teasing, abusing, startling, and quarreling.
8. Failing to use safe attire or personal protective devices (goggles, respirators, and helmets).

Mechanical or Physical Hazard

A mechanical or physical hazard is a faulty or negligent condition of the selected agency which should have been guarded against or corrected. Such "agencies" include machines, vehicles, power transmission apparatus, electrical apparatus, hand tools, chemicals, flammable or hot substances, dusts, radiation, and working surfaces, such as floors, ramps, roads, shelves, and stairs. Hazardous conditions include the following:

1. Improperly guarded agencies.
2. Defective agencies (rough, slippery, sharp, and inferior in composition).
3. Hazardous arrangements or procedures around the selected agencies (unsafe storage, congestion, and overloading).
4. Improper illumination (insufficient light, and glare).
5. Improper ventilation (insufficient air change, or improper air source).
6. Unsafe dress or apparel (lack of, or defective gloves, aprons, shoes, respirators, loose clothing).
7. Unsafe mechanical or physical conditions not classified elsewhere.

The Accident

Heinrich defines an accident as "an unplanned and uncontrolled event in which the action or reaction of an object, substance, person or radiation results in personal injury or the probability thereof."[9] An accident according to this definition does not necessarily involve injury. Indeed most accidents do not. In defining work accidents for the purpose of cost anaysis the National Safety Council says:[10]

> Work accidents are unintended occurrences arising out of employment. These accidents fall into two general categories. The first includes accidents resulting in work injuries. The second type includes accidents that cause property damage or interfere with production in such a manner that personal injury might have resulted.
>
> Accident types are listed as follows:
>
> 1. Striking against (refers generally to contacts with sharp or rough objects, resulting in cuts, slivers, punctures, etc., due to striking against, kneeling on, or slipping on objects).
> 2. Struck by (falling, flying, sliding, or moving objects).
> 3. Caught in, on, or between.
> 4. Fall on same level.
> 5. Fall to different level.
> 6. Slip (not fall) or overexertion (resulting in strain, hernia, etc.)
> 7. Exposure to temperature extremes (resulting in burning, scalding, freezing, heat exhaustion, sun stroke, frost bite, etc.)
> 8. Inhalation, absorption, ingestion (asphyxiation, poisoning, drowning, etc., but excluding contact with temperature estremes).
> 9. Contact with electric current (such as shock, etc.)
> 10. Accident type not elsewhere classified.

The Injury

The injury is the damage or hurt done or suffered as a result of the accident. In the accident sequence, injury includes work-connected disability and occupational disease. The United States of America Standards Institute (USASI) defines occupational disease as "a disease caused by environmental factors, the exposure to which is peculiar to a particular process, trade or occupation and to which an employee is not ordinarily subjected or exposed outside or away of such employment

In general terms, a disabling injury is one which results in death or permanent impairment or which renders the injured person unable to work for a full day on any day after the day of injury. The generally accepted definitions of these injuries are as follows:

1. **Death.** Death is any fatality resulting from a work injury, regardless of the time intervening between injury and death.

2. **Permanent total disability.** Permanent total disability is an injury other than death which permanently and totally incapacitates an employee from following any gainful occupation, or which results in the loss of or the complete loss of use of any of the following in one accident: (a) both eyes; (b) one eye and one hand, or arm, or foot, or leg; (c) any two of the following not on the same limb: hand, arm, foot, and leg.

3. **Permanent partial disability.** Permanent partial disability is any injury other than death or permanent total disability which results in the complete loss or loss of use of any member or part of a member of the body, or any permanent impairment of functions of the body or part thereof, regardless of any pre-existing disability of the injured member or impaired body function.

4. **Temporary total disability.** Temporary total disability is any injury which does not result in death or permanent impairment, but which renders the injured person unable to perform a regularly established job which is open and available to him, during the entire time interval corresponding to the hours of his regular shift on any one or more days (including Sundays, days off, or plant shutdown) subsequent to the date of the injury.

The Systems Approach

The systems approach to accident prevention in school shops and laboratories, as presented on the following pages of this Guide, is based on a presentation given by W. G. Johnson, General Manager of The National Safety Council, to the NSC Board of Directors on October 26, 1965.[12]

To understand the systems approach, we must first have a clear definition of a system. Definitions which might serve our purpose include the following:

> A set or arrangement of components so related or connected as to form a unity or organic whole. A set of facts, principles, rules, etc., classified or arranged in regular, orderly form so as to show a logical plan linking the various parts. A method or plan of classification. An orderly arrangement of independent activities and related procedures which implements and facilitates the performance of a major activity of an organization. A set of components, man or machine or both, which has certain functions and acts and interacts, one in relation to another, to perform some task or tasks in a particular environment or environments. Any configuration of elements in which the behavior properties of the whole are functions of both the nature of the elements and the manner in which they are combined.

One additional definition may be helpful:

A systems analysis can clarify a complex process by devising a chart or model that provides a comprehensive overall view of the process by showing its principal elements and the ways in which they are inter-related. The use of this approach facilitates the discovering of weaknesses, omissions or errors in the process. It is intended that the elements be quantified.

Systems are task-oriented. In any system, there are continuous, dynamic interactions among the subsystems, components or parts. In Figure 1 we see a simple illustration of the basic interacting elements of a school shop or laboratory task–PEOPLE x TOOLS x ENVIRONMENT. This is often expressed as MEN x MACHINES x MEDIUM, or more simply as PEOPLE x PLACES x THINGS.

- An auto-body repair student uses a welding torch to repair a gas tank.
- A beauty culture student, her hand in a manicure solution, reaches up to turn on a dryer.
- A cabinet-making student uses a jointer to surface a piece of wood stock.
- A carpentry student drives a truck along a road to deliver cabinets to a house construction job.
- A chemistry student uses laboratory apparatus to make distilled water.

But what about accidents? As shown in Figure 2, accidents interrupt task performance and injure people, damage tools and equipment, and may damage the environment–*e.g.*, burn up the shop. Shop accidents result from deficiencies, malfunctions or failures in students, in tools or in environment–most accidents result from deficiencies in all three and sometimes even a deficiency in the established task or objective. Thus, faults among the interacting parts of the system can result in accidents.

- An impatient machine shop student and a mushroomed cold chisel.
- A hurrying laboratory student and a slippery floor.
- A beginning welding student and a defective acetylene torch.
- A square set screw on a revolving shaft.
- A cracked abrasive wheel on a high-speed pedestal grinder.

Thus, failure to evaluate the potential hazards resulting from the possible interactions of all the elements of a system can, through a sort of tunnel vision, result in overlooking important causes of accidents.

Decision-making agents are found on all levels of our society–governors and mayors, legislatures and city councils, special authorities and the counties, organizations and their members,

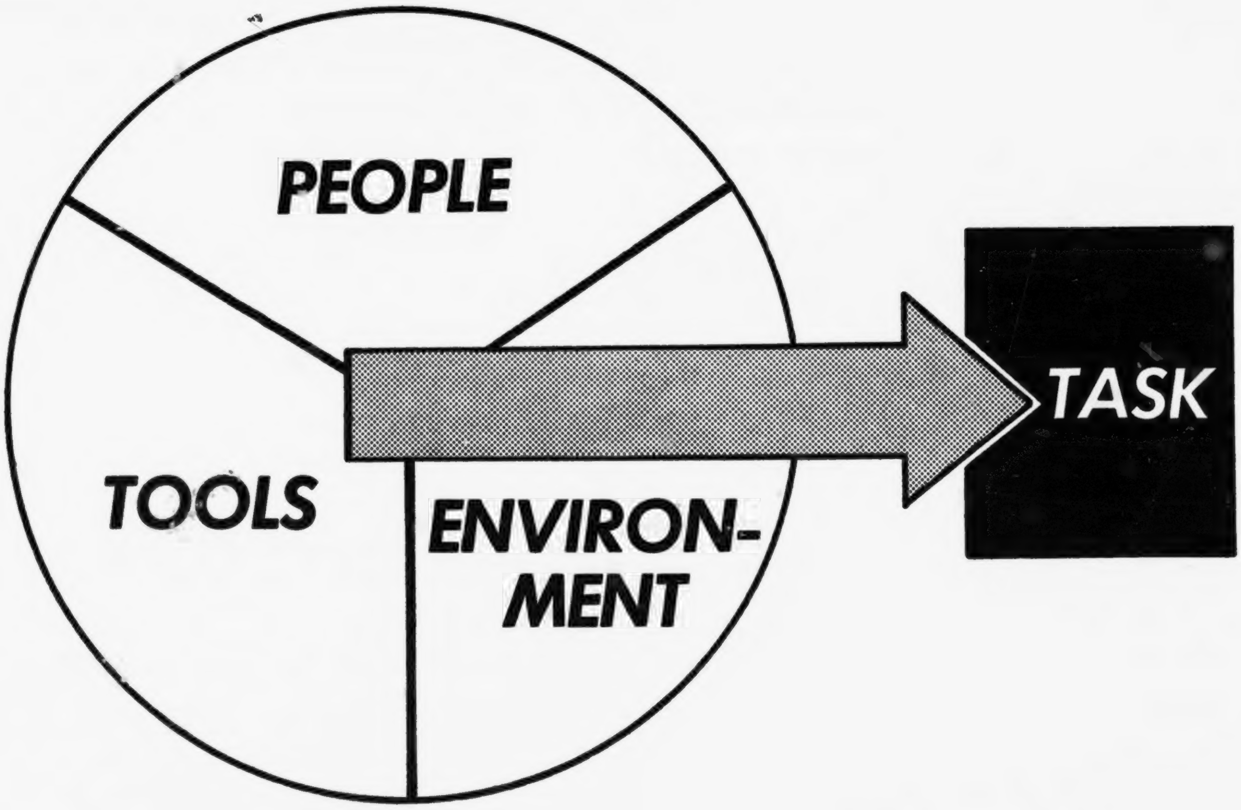

PEOPLE
TOOLS
ENVIRONMENT
TASK

Fig. 1

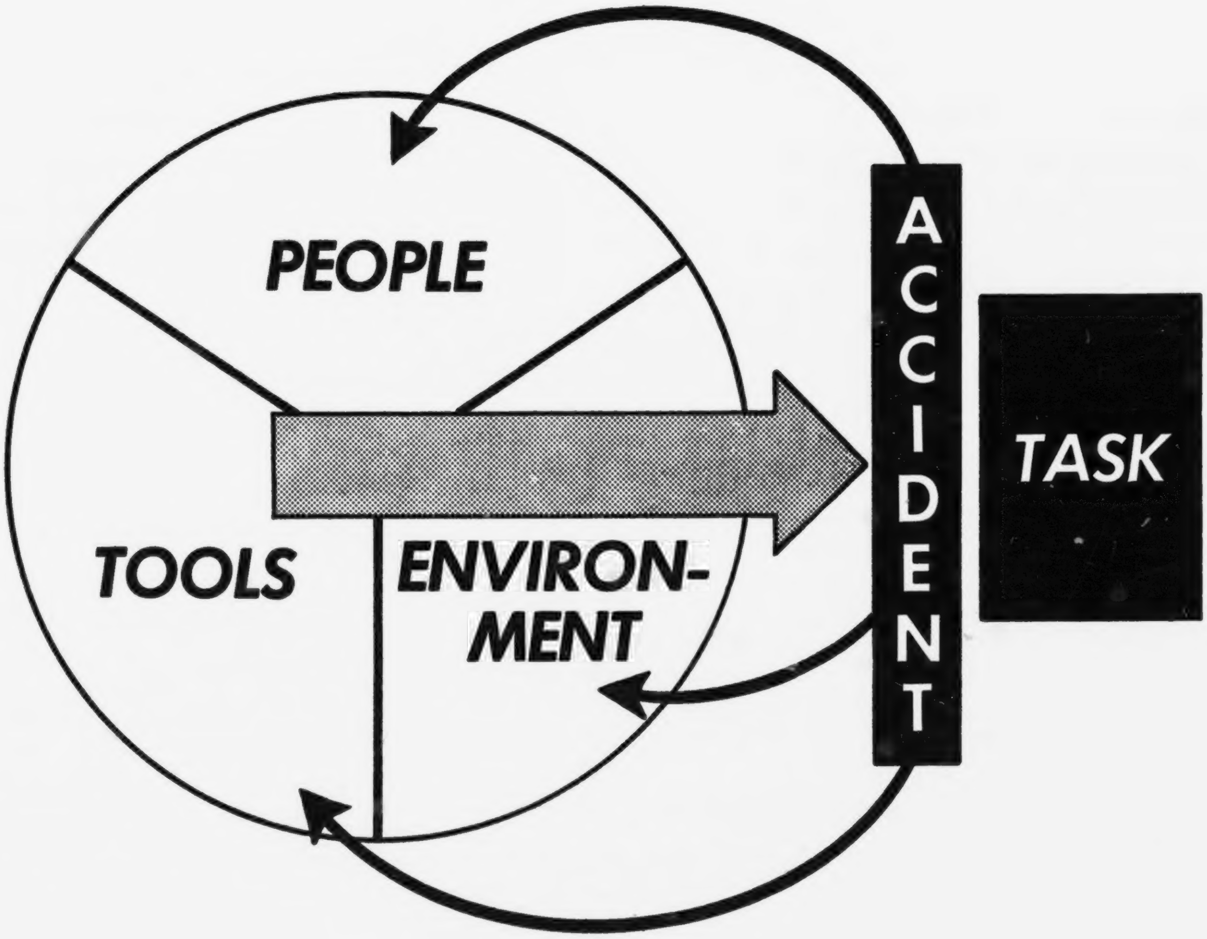
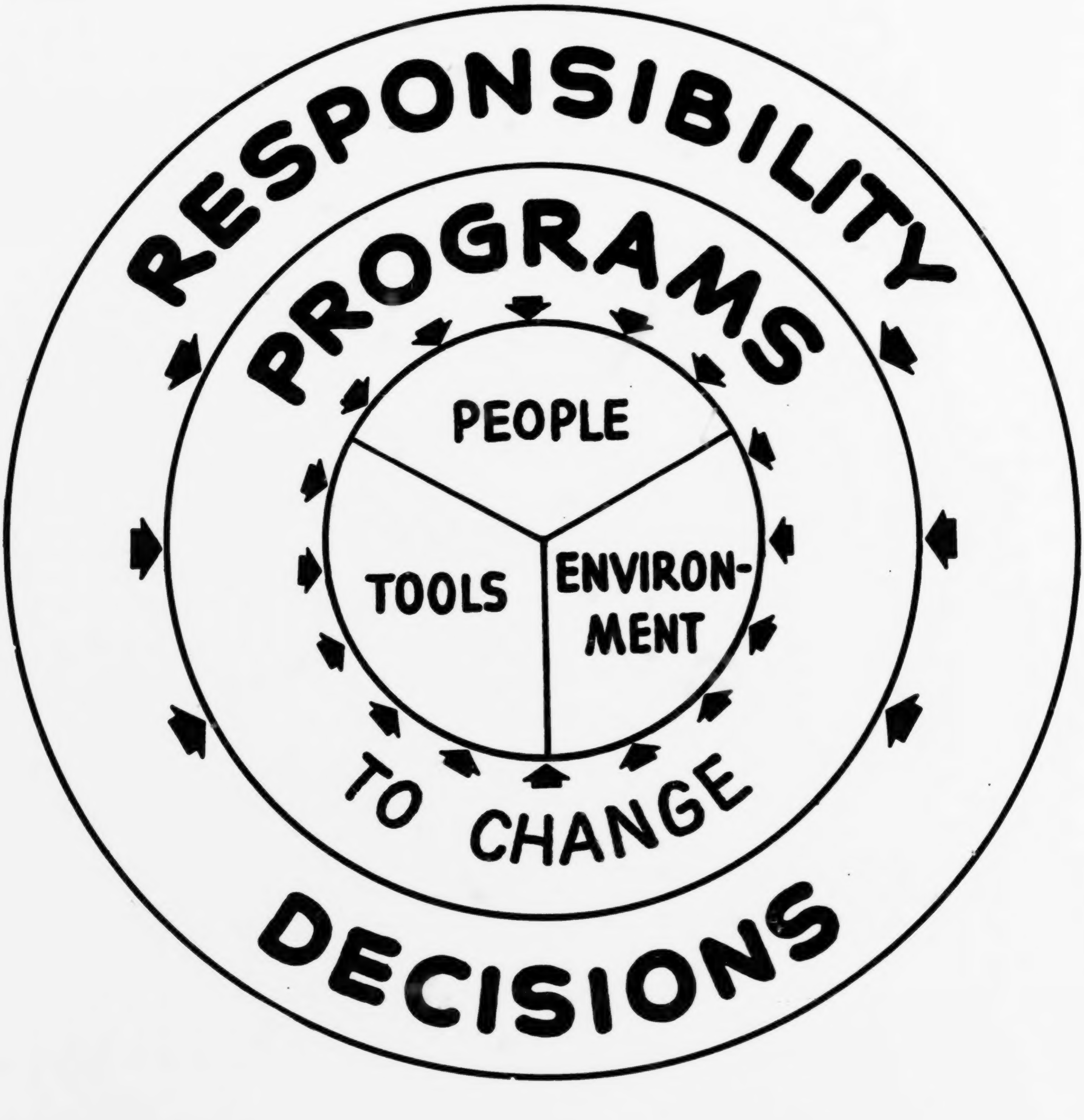

ACCIDENT
PEOPLE
TOOLS
ENVIRONMENT
TASK

Fig. 2


RESPONSIBILITY
PROGRAMS
PEOPLE
TOOLS
ENVIRONMENT
TO CHANGE
DECISIONS

school boards and superintendents, business and industry as employers, and parents. How can accidents in school shops and laboratories be prevented? Those *responsible* must make *decisions* which result in preventive *programs* (Figure 3).

1. **Programs for people**–training, knowledge, skill, attitude formation, firm supervision, administration, control of unsafe behavior, and counseling to overcome handicaps.

2. **Programs for equipment**–safe design, proper maintenance, right tool for the job; control of power directed toward task performance rather than toward accidents; personal protective clothing; and equipment.

3. **Programs for enviornment**–building engineering, shop and laboratory layout; color combinations, lighting, ventilation, flooring, fire prevention and control, housekeeping, and storage.

Accidents generate economic losses, while performance of the task safely generates social, economic, and personal benefits. The total benefits justify the investments and controls which can reduce accident. How much can be done to reduce accidents? Figure 4 introduces some criteria into the system.

We now see safety as a four-step system:

1. The basic elements to be modified (Figure 1).

2. The programs which are the modifiers (Figure 3).

3. The decision-responsibility level for program authorization and finance (Figure 3).

4. The services required by decision-makers and programmers (Figure 5).

Educational decision-makers and program planners are not self-sufficient–**services** are needed. These include (Figure 5) services from national agencies, such as The National Safety Council, American Society of Safety Engineers, U.S. Department of Labor, United States of America Standards Institute, and the National Commission on Safety Education of the National Education Association, to states and larger cities; services from states to smaller cities and counties; and services of state and local safety councils and steering committees to state and local groups. Nor should the skilled voluntary assistance available to schools from local industry and business be overlooked. Types of services needed include research and fact finding, exchange of information, standards or recommendations, training, technical assistance, program aids, measurement of performance, recognition of achievement, and means for coordination.

What are the practical values of the systems approach? *First,* this approach can help to provide a better definition of accident prevention. *Second,* this approach can help to provide an improved statement of principles of accident prevention. *Third,* a large measure of agreement and a fuller mutual understanding of accident-prevention steps can indicate what should be done, and by whom, in any situation. The relative roles of governmental and private agencies in accident prevention will be easier to identify (Figure 6).

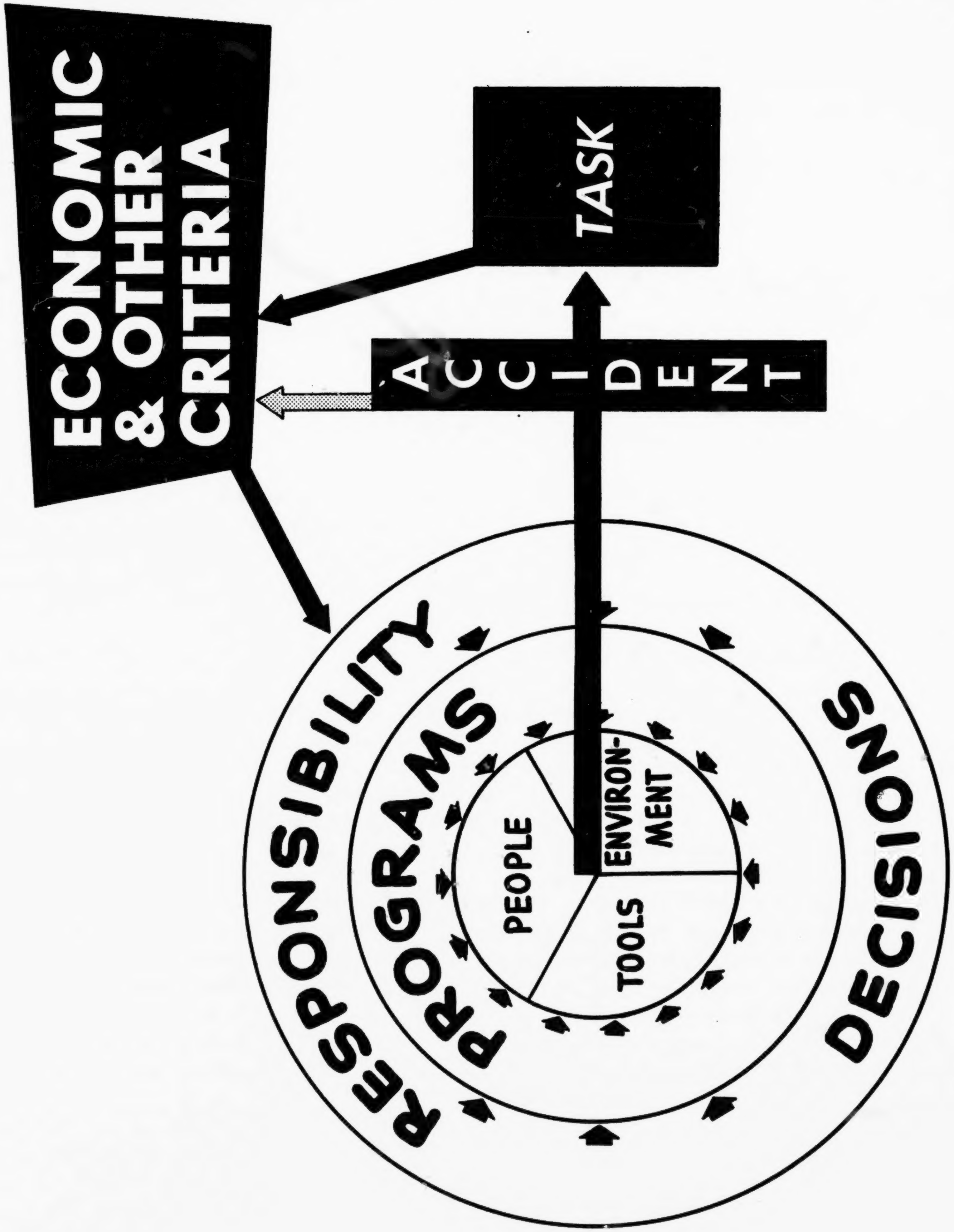

ECONOMIC
& OTHER
CRITERIA
TASK
ACCIDENT
RESPONSIBILITY
PROGRAMS
DECISIONS
PEOPLE
TOOLS
ENVIRON-
MENT

Fig. 4

The Right Way

Some years ago a staff group within The National Safety Council developed an outline of the steps in an accident prevention methodology. The steps were entitled *The Right Way:*

1. Define the objective.

2. Identify hazards.

3. Prepare a sound plan.

4. Fix responsibilities.

5. Seek good facilities.

6. Use proper equipment.

7. Build knowledge and skill.

8. Supervise performance.

9. Learn from experience.

10. Evaluate programs.

William G. Johnson of the Council said that, "This methodology is not simply an accident prevention methodology. It is a systematic approach to accomplishing anything. In the sense of advanced planning, *The Right Way* crystalizes ten elements that help to unify the many fields of human activity and also important help to improve the activity itself. *The Right Way* clearly shows our dependence on responsible people who reduce the frequency and severity of accidents in the activities they supervise."

Mr. Johnson further stated that, "Only by constantly questioning accepted methods can we hope to make progress in accident prevention. Only by adopting a total safety concept can we build toward an accident free environment. No matter how specialized our particular area of accident prevention may be, it must be viewed in its proper relationship where there are other areas if it is to attain maximum effectiveness."

Overview of the Guide

A program of safety education must operate throughout the entire school and be fully integrated into every aspect of daily activities if it is to achieve optimum results. Isolated activities conducted independently of a comprehensive plan fall short of desired results. The efforts of all members of the faculty (teachers and administrators), student body, and janitorial staff must be solicited and coordinated for best results. Chapter 2 describes the necessary development and the procedures employed in the organization of an effective accident prevention

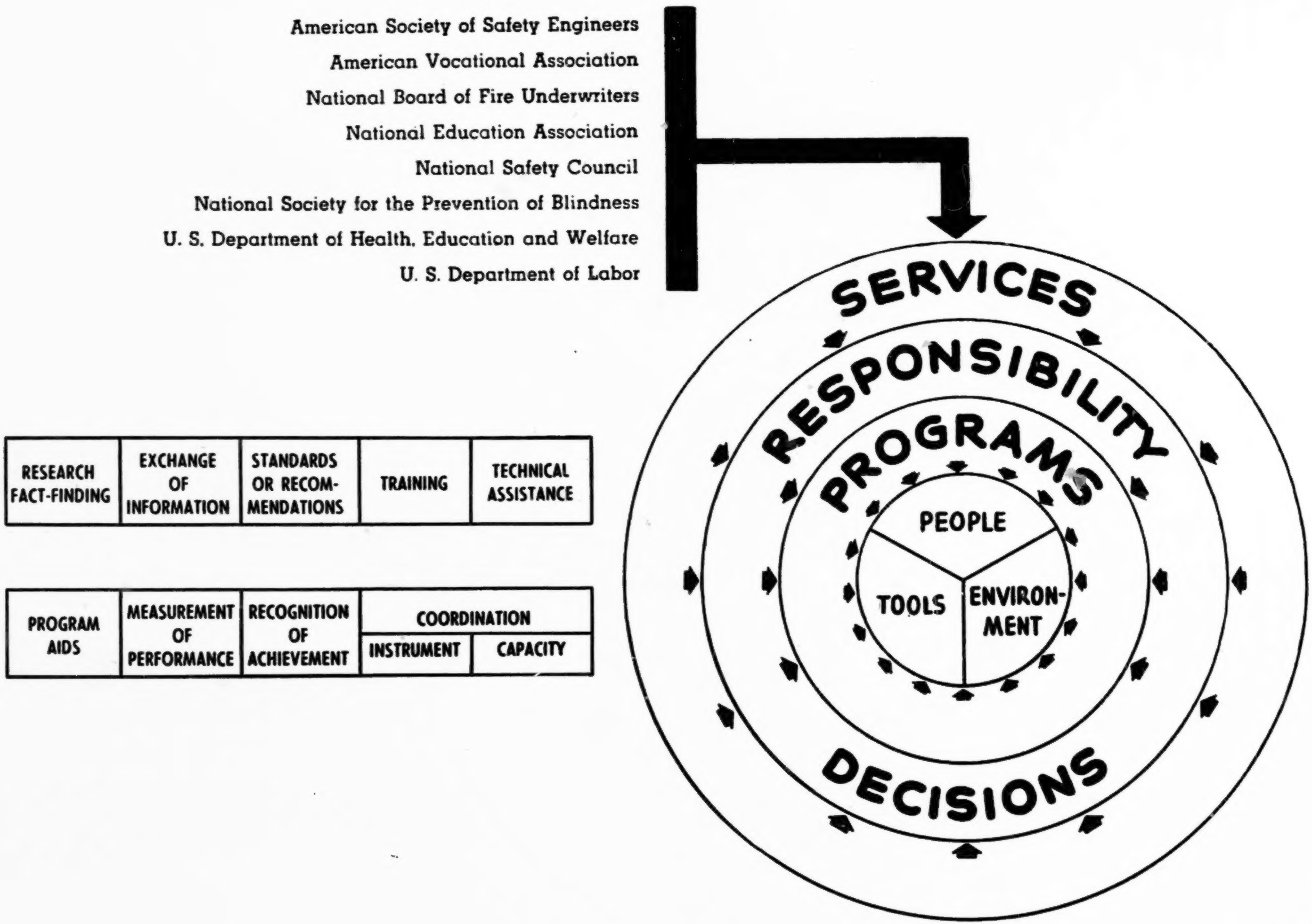

American Society of Safety Engineers
American Vocational Association
National Board of Fire Underwriters
National Education Association
National Safety Council
National Society for the Prevention of Blindness
U. S. Department of Health, Education and Welfare
U. S. Department of Labor
SERVICES
RESPONSIBILITY
PROGRAMS
PEOPLE
TOOLS
ENVIRON-MENT
DECISIONS
RESEARCH FACT-FINDING
EXCHANGE OF INFORMATION
STANDARDS OR RECOM-MENDATIONS
TRAINING
TECHNICAL ASSISTANCE
PROGRAM AIDS
MEASUREMENT OF PERFORMANCE
RECOGNITION OF ACHIEVEMENT
COORDINATION
INSTRUMENT
CAPACITY

Fig. 5

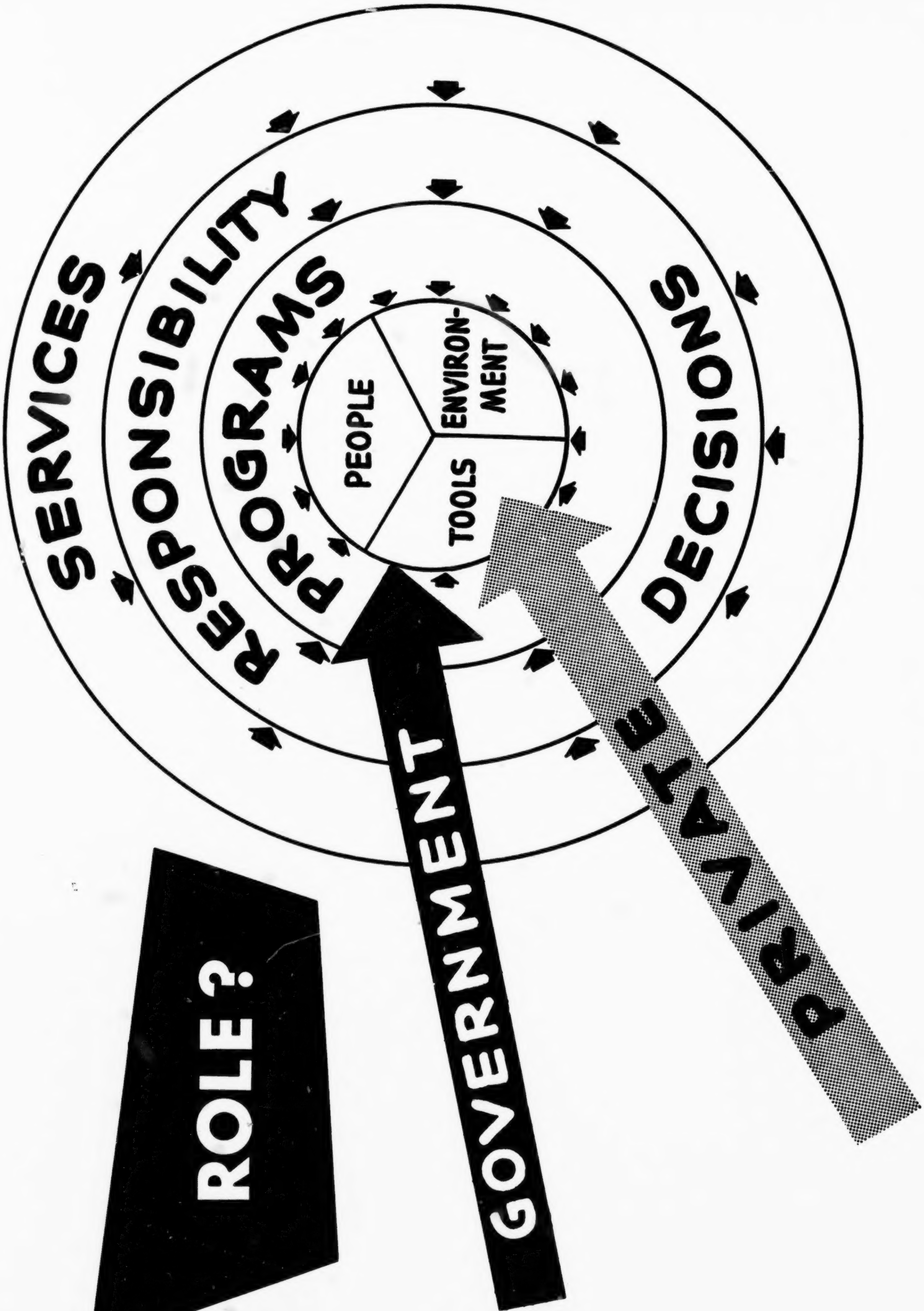

SERVICES
RESPONSIBILITY
PROGRAMS
PEOPLE
ENVIRON-
MENT
TOOLS
DECISIONS
GOVERNMENT
PRIVATE
ROLE ?

Fig. 6

program for school shops and laboratories. Chapter 3 emphasizes some of the principles necessary for the administration of a program of accident prevention. The need for a statement of principles and the identification of these principles are presented.

The keystone of an effective school shop and laboratory accident prevention program is the teacher. The safe practices he employs in his instructional situation will serve to 1) protect the students from bodily harm, 2) minimize damage to building facilities and equipment, and 3) provide experience to students as future employees in the development of safety concepts which apply to all occupational fields. Chapter 4 summarizes the steps involved in the implementation of an accident prevention program in school shops and laboratories: *An accident which can be predicted is an accident which can be prevented.* The prediction of accidents can come only through a comprehensive accident investigation, reporting, and analysis system.

Because people are a necessary part of an effective-accident prevention program, the education and training of these individuals are also necessary. Chapter 5 offers suggestions for the education and training of professional and non-professional school personnel as well as the education and training of the students enrolled in shop and laboratory courses.

REFERENCES

1. Detroit Public Schools, *Summary of School Child Accidents and Personnel Accidents*, 1964-65, File No. 7549, Division for Improvement of Instruction, Department of Safety Education, October 1965.

2. National Safety Council, *Accident Facts,* Current Edition, National Safety Council, 425 N. Michigan Ave., Chicago 60611.

3. U.S. Department of Labor, Bureau of Labor Standards, *Report of Work Injuries to Minors Under 18 Years of Age,* Bulletin 282, U.S. Government Printing Office, 1966, Washington, D.C. 20402.

4. National Safety Council, *Accident Prevention Manual for Industrial Operations,* 5th ed., 1964 pp. 1-1 and 1-2, National Safety Council.

5. William A. Williams (ed.), *Accident Prevention Manual for Shop Teachers,* American Technical Society, 1963, pp. 344.

6. H. W. Heinrich, *Industrial Accident Prevention,* 4th ed.(New York 10036: McGraw-Hill Book Company, 1959) pp. 14-15.

7. *Ibid,* p. 83.

8. National Safety Council, *op. cit.* p. 10-4.

9. H. W. Heinrich, *op. cit.* p. 16.

10. National Safety Council, *op. cit.* p. 10-9.

11. United States of America Standards Institute, New York 10016, *Recording and Measuring Work Injury Experience,* Z16. 1-1954-R-1959, p. 6.

12. W. G. Johnson, *Systems Development;* an unpublished report to the Board of Directors, National Safety Council, October 26, 1965.

CHAPTER 2

ORGANIZING FOR ACCIDENT PREVENTION

An accident prevention program in school shops and laboratories does not just happen—school systems with low accident rates *plan* their safety programs. Administrators work hard to organize them and continue to work diligently to keep them operating effectively and efficiently. The result is a relatively accident-free climate, providing educational activities where injuries to students, work interruption, and damage to school property or equipment are kept to a minimum. Such a program must be built upon a solid foundation and this foundation must include the most important single factor in aiding accident prevention—the basic philosophy of the school administration given in an unequivocal statement of policy. Such a policy will determine both the function and the role of accident prevention integrated into the total school program as well as supporting specific actions which will insure the success of an accident prevention program in school shops and laboratories.

The next step taken after a solid philosophical foundation has been laid is organization. The safety organization is the mechanism by which the accident prevention program is directed, coordinated, and controlled. The task of accident prevention is complicated and cannot be undertaken in a random manner. A planned and systematic effort is required at all levels. Organization is the means by which individuals work as a group. It consists of people working with people and groups working with groups in an orderly division of activity, or, in other words, the determination and correlation of individual and group tasks in a unified effort to carry out administrative policies.

This chaper deals with the organization of an accident prevention program for school shops and laboratories. It presents:

1. Principles of organization.

2. Organizational structure.

3. Steps in organizing the program.

4. Policies.

5. Responsibilities.

6. The safety committee.

7. Cooperating agencies.

PRINCIPLES OF ORGANIZATION FOR ACCIDENT PREVENTION

It should never be assumed that the principles of organization for accident prevention in school shops and laboratories apply equally in all situations. Situations are often dissimilar and seldom identical. Therefore, to consider a given set of principles as being applicable in all situations cannot be justified. Certainly the responsible administrator must know the principles, but he must apply them with judgment, having first analyzed the particular situation. He must question their validity in the light of the operations or tasks required and consider each of the principles to determine its appropriateness.

The principles of organization that follow are based on principles that have developed over the years and have emerged from the experiences of various groups–business, governmental, educational, religious, and military.

Principle No. 1–The master plan is developed under the direction of the chief school administrator.

Master plans for accident prevention in school shops and laboratories are developed on the state and local level by chief school administrators with the advice and counsel of safety education specialists.

The **state accident prevention plan** outlines: the objectives of the program; the relationships with local school districts, cooperating governmental agencies, and cooperating safety agencies; the organization pattern; the legislative, inspectional, and fact-gathering functions; and the responsibilities of individuals assigned to the program. The chief state school officer is responsible for the development of the plan. (See Appendix A for a format of the state accident prevention plan.)

The **local accident prevention plan** outlines: the objectives; the relationships with the state organization, cooperating governmental agencies, and safety agencies; the organizational pattern; the inspectional and fact-gathering functions; and the responsibilities of individuals involved in the program. The local superintendent is responsible for the development of the local plan. (See Appendix B for a format of a local accident prevention plan.)

The **individual shop or laboratory accident prevention plan** includes: a statement of objectives; layout and facilities of the shop; details of the shop operation and maintenance; a description of the equipment used for protection of the student; a list of general and specific safety practices and regulations; safety instruction plans; a description of student participation in the safety program; and the policy for making accident reports and analyses. (See Appendix C for a format of a shop or laboratory accident prevention plan.)

Principle No. 2–Active participation and cooperation of all individuals and groups affected are desirable in the planning of a program.

This application of democratic procedures insures maximum cooperation in executing the program; this approach should not, however, be used as a device for evading individual responsibility or decision-making. In the planning of the state program it is desirable to consult agencies such as the National Safety Council, American Society of Safety Engineers, the National Commission on Safety Education of the National Education Association, as well as state labor and health services. State specialists in the fields of agriculture, education, trade, and industrial education, industrial arts, and technical education should, of course, be included in the preparation of state plans. Local planning should involve teachers from all shop and laboratory instructional areas and others responsible for non-instructional functions in the school routine. All groups in the school structure must be considered, including the non-instructional staff. Group representation is essential for stimulating safety on a group basis as well as on an individual basis. In the planning of individual shop or laboratory plans, it is desirable to involve students to insure total representation of personnel. Representatives of local chapters of the American Society of Safety Engineers should be involved as well. Other local agencies which should participate include insurance services, chapters of the Associated General Contractors of America, colleges and universities, community safety councils, fire departments, municipal health agencies, police departments, and professional medical personnel.

Principle No. 3–Every function necessary for accomplishing the aims and objectives of the organization is assigned to an individual or subdivision of that organization.

Organization exists for one purpose–to make sure that all essential activities are carried out. The responsibilities of each major element of the state organization for accident prevention must be analyzed to determine the functions essential to fulfill its responsibilities. This is also true of the local organization. When the functions are determined, they are then assigned to an individual or a subdivision of the organization, whether it be state or local. This principle should not be a interpreted as an encouragement to add unnecessary activities. It applies only to jobs which must be done. Essential functions, however, must not be overlooked in creating the organization plan.

Principle No. 4–Uniform methods of organizational structure are applied at each level of the organization.

This principle refers to the basis used in establishing the form of organization. Administrators must make the decision regarding the form of the organization before the plan of any operation can be properly determined. There are three reasons for adherence to a standard pattern:

1. To simplify relationships and procedures.

2. To provide the best organizational structure at all levels.

3. To provide a simple basis for general understanding and recognition of the exact delegation of responsibilities.

Principle No. 5–Organizations should never be permitted to grow so elaborate as to hinder work accomplishment.

In order to secure the accomplishment of minor activities, an organization frequently is permitted to establish an excessive number of separate units. This is an error, since it may result in an inflexible organization structure requiring more personnel than necessary. Separate organization positions should be confined to those which have a distinct and separate job to perform.

Principle No. 6–Assigned responsibilities are specifically clear-cut and understood.

This principle has two purposes:

1. To prevent confusion of lines of authority, inevitably leading to conflicts, duplications and overlaps of function with other agents of the organization.

2. To insure that the agency concerned clearly understands the exact nature of its job and the steps necessary to perform that job.

Vague wording of regulations, memoranda, directives, or circulars must be avoided, since the result is overlapping, duplication and conflicts between units charged with similar functions. The resulting confusion may be so extensive that it prevents or delays action. Directives and other instruments prescribing authority must be clearly and concisely written and readily understandable. They should be checked to make sure that there are no ambiguities or sources of possible misunderstandings. Interpretations should be made by a specified individual at the administrative level.

Principle No. 7–Responsibility for a function is matched by the authority to perform that function.

A delegation of responsibility must be accompanied by the authority to act, if quick and decisive action is to be obtained. No person or group of persons within an organization can really be held responsible for the performance of any job unless the responsibility is accompanied by the power to accomplish that mission or execute that job. Frequently the delegation of responsibility fails to carry with it the necessary authority or is accompanied by checks that make the performance of the assigned task unnecessarily difficult. This principle must be carried out to make an accident prevention program effective.

Principle No. 8–Functions are assigned so that related functions are grouped together.

Grouping related functions together facilitates the grouping of individuals under a supervisor and the grouping of subdivisions related within the organizational structure.

Principle No. 9–Authority and responsibility are decentralized to the maximum extent consistent with control.

This principle places in the hands of those closest to actual operations the authority and responsibility necessary for the conduct of those operations or tasks. A responsible individual at the scene of operations is able to appreciate more fully the peculiar conditions confronting him than someone in a distant office. Subordinates should be given sufficient authority to act in all cases where review by higher authority is not absolutely essential.

Principle No. 10–Special skills and talents of individuals are utilized for the greatest benefit to all.

Good organization utilizes the talents of all members of the staff for the greatest benefit to all. The school administrator will make himself aware of the special abilities and educational background of supervisory and teaching personnel, and assign them to positions where they can do the most good. For example, some staff members may have special abilities and training in fire safety, personal protection, or hygiene. These special talents may be utilized in solving special problems throughout the school program or in particular areas, as well as in actual classroom work.

Principle No. 11–Major attention is given by senior officials to problems of exceptional importance with only the minimum necessary attention given to reviewing routine actions of subordinates.

It is better to delegate discretionary authority to subordinates at the risk of a few mistakes than to retard performance with cumbersome routines of direct supervision and review. Subordinates should be impressed with their responsibility for reporting unusual policy problems to their superiors and with their duty to act promptly and decisively on routine functions without reference to higher authority. One of the most common manifestations of over-attention to detail is the insistence of many administrators and supervisors on personally signing routine correspondence. This policy delays actions.

Principle No. 12–Every member of the organization, from top to bottom, knows to whom he reports and who reports to him.

The line of authority must show clearly to whom each individual is responsible and for whose performance each supervisor is responsible. This principle is essential to the effectiveness of the organization of any type of enterprise. It is especially important in an accident prevention program since the safety of individuals is at stake.

Principle No. 13–The number of individuals or agencies reporting directly to one supervisor is kept within the number that he can effectively control.

No fixed formula can determine the number of people that can work effectively under the supervision of one man under varying circumstances. The extent of the span of control depends in great measure upon the nature of the work being performed. The span of control must be sufficiently limited to insure adequate attention by each supervisor to each of his principal subordinates. Obviously, time, space, nature of activities, and personalities will have a direct bearing on this matter. In a school shop or laboratory situation where the teacher is the supervisor the class size should not exceed a total of 25, nor should the total exceed the number of training stations available to carry on the instructional activities of the program of instruction. From an organization standpoint, this principle is sound. From an accident prevention standpoint, the principle is more than sound, it is essential.

Principle No. 14—No member of an organization is required to report to more than one supervisor.

The effectiveness of a person is inevitably hampered if he is required to report directly to more than one superior. In an effort to follow the instructions of one he may violate the instructions of the other. The word "reports" refers to lines of authority and responsibility only. This does not mean that an individual may not talk with others to obtain their advice, counsel, and guidance in the performance of duties.

Principle No. 15—Channels of administration are not violated by individuals or subdivisions of the organization.

All personnel in an organization should clearly understand the limitations of their authority and of their functions. Staff personnel are assistants to the administrator; all their authority flows from him and must be exercised in his name. Few organizational problems cause more difficulty than the failure to understand clearly the difference between line and staff activities in spite of the fact that the distinctions between them are logical and clear-cut.

Organizational Structure

In April 1959, the Office of Education of the U.S. Department of Health, Education, and Welfare conducted the "Office of Education Conference on the School's Contribution to Occupational Safety Through Shop Safety Programs." The purpose was to explore approaches for more effectively coordinating and implementing the efforts of local schools to make their maximum contribution to the development of safety consciousness on the part of young people enrolled in school shops. This conference brought together 76 participants from 21 states representing 42 organizations and agencies concerned with safety education. The conferees spent two and one-half days in discussions of areas such as leadership development, safety committees, physical patterns, instructional materials, and teacher education. The report of the conference[1] contains a digest of the findings, a set of recommendations, and a summary of the discussions. Among the recommendations made by the conference were the following which are pertinent to the organizational structure on a state and local level; they are of course equally applicable to school laboratories:

1. Each state should appoint a safety education committee to advise the chief state school administrator on matters relating to school shop safety education. This committee should represent public and private agencies and industrial groups with an interest in the field of occupational safety.

2. Each state should employ a professionally trained safety education director or coordinator to serve on the staff of each chief state school administrator. This pattern could be repeated in the lower administrative echelons of the school system as well.

3. School shop safety programs should be organized at the community level. The responsibility for organizing these programs should be the responsibility of local school administrators and school boards.

Organizational structures consist of two types of officers: line officers and staff officers. The line officers are administrative executives such as department heads within a school, building principals, assistant superintendents, and superintendents. They are in charge of departments in a school, single buildings, groups of buildings, or major divisions of the educational system. The flow of authority is from superintendent or assistant superintendent to principals to teachers. Dualism of control is thus eliminated, and the policy of a single executive is maintained through all departments and levels of administration. Thus, line officers systematically operate the educational program. Obviously, under this system supervision may be emphasized or subordinated depending upon the policy and point of view of the superintendent. Staff officers are technical experts in charge of service or subject departments or departments including groups of subjects. Staff officers are advisory experts directly responsible to and operating through the superintendent of schools. Staff officers have no administrative authority over line officers or teachers. Expert technical services involved in supervision are provided for through the organization of the staff departments either for services or subjects. A safety education director or coordinator is an example of a staff officer. Other examples might include: curriculum specialist, maintenance specialist, statistician, personnel director, or music director.

State Organization

Figure 7 represents a suggested pattern for the organization of the accident prevention aspects of a state education office. There are four distinctive elements in this pattern: 1. the chief state school officer; 2. a safety director or coordinator; 3. a safety steering committee, and 4. the subject area specialists.

The **chief state school officer** is the state superintendent of schools or superintendent of public instruction. In this position rests the basic responsibility for the organization of the accident prevention program for school shops and laboratories. This responsibility is an important challenge, since, as head of the school system, the chief state school officer must effectively set the stage for the eventual success of the program. The responsibility for planning details within the framework of the program may be delegated to other personnel, but coordination must come from top level administration. An essential factor in a successful accident prevention program is the active top-level endorsement of the program after it has been formulated and put into effect.

The **safety director** serves in a staff capacity without line authority. He functions both as a special assistant and advisor to the state superintendent on accident prevention and as the advisor on safety for the entire organization. He must work closely with members of the supervisory staff without interfering with any of their functions. He must realize that his is a service job and that he cannot encroach on the authority of members of the line personnel. His specific duties are outlined in a subsequent section of this chapter. The safety director is selected for his training, experience, interest, and ability in the area of safety in school shops and laboratories.

The **safety steering committee** is appointed by the state superintendent to serve in an advisory capacity on matters of:

STATE ORGANIZATION

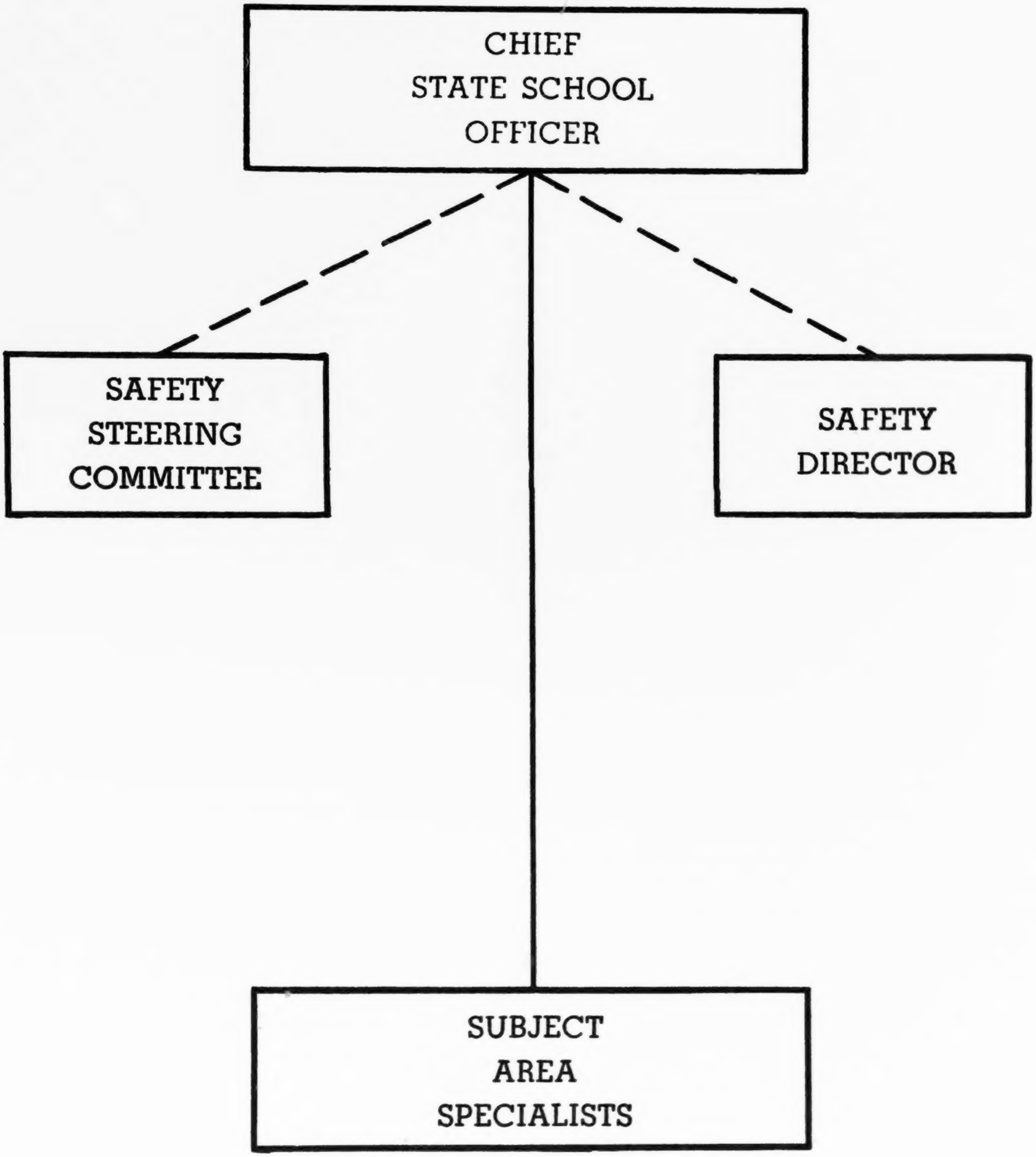

CHIEF STATE SCHOOL OFFICER
SAFETY STEERING COMMITTEE
SAFETY DIRECTOR
SUBJECT AREA SPECIALISTS

Fig. 7

1. Assessment of the accident prevention situation in school shops and laboratories;
2. formulation of a master plan of action;
3. testing the effectiveness of the plan;
4. revising the plan on the basis of test results; and
5. projecting plans for the further advancement of the accident prevention program.

The chief state school officer or his representative should serve as chairman with membership of the group to be made up of the following:

1. State director of vocational education.
2. State supervisor of trade and industrial education.
3. State supervisor of industrial arts, or another individual responsible for supervision of this activity.
4. State supervisor of vocational agriculture.
5. State supervisor of technical education.
6. Representatives of these or similar groups: a) state federation of labor; b) insurance and casualty organization; c) state teachers' organizations; d) state safety council; 3) state chamber of commerce; f) farm organizations; g) institutions of higher learning which provide educational services to school shop programs; h) state trade associations; i) state factory inspection services; j) state industrial commissions; and k) American Society of Safety Engineers.

The **subject area specialists** are the state supervisors and coordinators who work directly with local educational personnel in their operation of educational programs conducted in school shops and laboratories. The subject areas include industrial arts, trade, industrial education, agriculture education, home economics education, technical education, distributive education, business education, natural sciences, and others.

Local Organization

Figure 8 represents a suggested pattern for the organization of the accident prevention aspects of a local education office (county, district, joint, city, etc.). There are six distinctive elements in this pattern:

1. The local superintendent of schools.
2. A safety director or coordinator.

3. A safety steering committee.

4. The school principals.

5. The subject area specialists.

6. School shop and laboratory teachers.

The primary responsibility for the organization of the local accident prevention program rests with the **superintendent of schools.** He must be able to express his beliefs on accident prevention in statements that will justify the proposed safety program. It is expected that his statement of purpose will capture the imagination of his staff and genuinely inspire and motivate the group.

The **safety director** serves in a staff capacity without line authority. He functions both as a special assistant and an advisor to the superintendent of schools on accident prevention and as the advisor and stimulator for safety for the entire local organization. He must work closely with members of the supervisory staff, but he cannot interfere with any of their functions. He must realize that his is a service job and that he cannot encroach on the authority of the members of the line personnel. His specific duties are outlined in a subsequent section of this chapter. The local safety director is selected for his training, experience, interest, and ability in the area of safety in school shops and laboratories.

The **local safety steering committee** is appointed by the superintendent of schools to serve in an advisory capacity in the following areas:

1. Assessment of the accident prevention situation in the school shops and laboratories.

2. Formulation of a master plan of action.

3. Testing the effectiveness of the plan.

4. Revising the plan on the basis of test results.

5. Projecting plans for the further advancement of the accident prevention program.

The local superintendent of schools should serve as chairman, with membership of the group to be made up of the following:

1. Local director of vocational education.

2. Local supervisors of vocational education areas.

3. Local supervisor of industrial arts, or another individual responsible for supervision of this activity.

4. Representatives of these or other like groups; a) insurance services; b) local chapter of

LOCAL ORGANIZATION

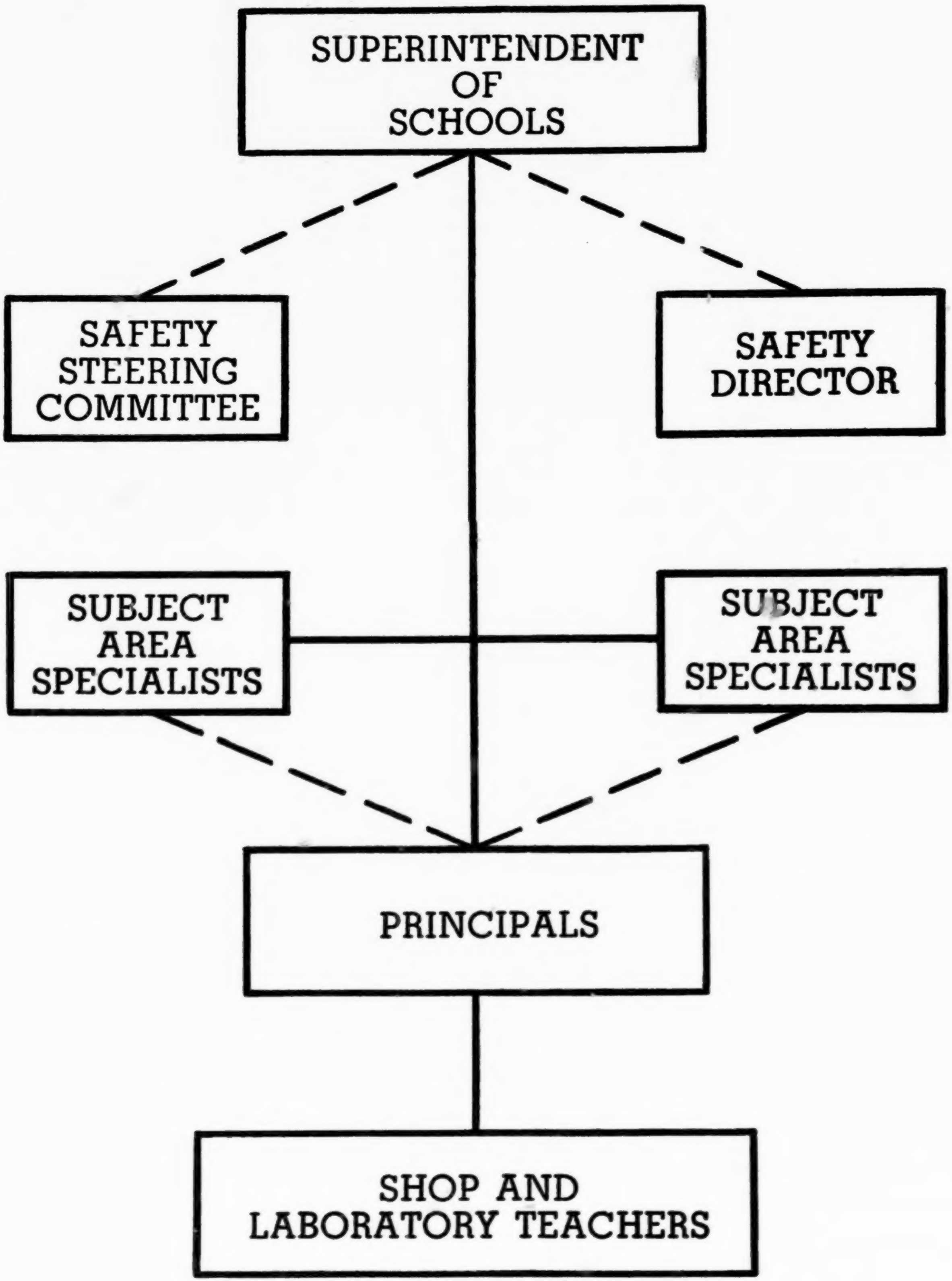

SUPERINTENDENT OF SCHOOLS
SAFETY STEERING COMMITTEE
SAFETY DIRECTOR
SUBJECT AREA SPECIALISTS
SUBJECT AREA SPECIALISTS
PRINCIPALS
SHOP AND LABORATORY TEACHERS

Fig. 8

the Associated General Contractors of America, Inc.; c) colleges and universities; d) community safety councils; e) fire departments; f) municipal health agencies; g) police departments; h) professional medical personnel; and i) safety engineers from local industries or a member of the American Society of Safety Engineers.

The individual school is the central unit of an educational system. Therefore, the **principal** is likely to be the administrator who is most directly concerned with the school shop and laboratory accident prevention program. If a specialized supervisor or department head functions under the principal and works directly with the teachers, some of the responsibilities for the program may be delegated to him. The supervisor or head teacher of industrial arts may be responsible for the program in industrial arts, but the chief responsibility for direct leadership in the school remains with the principal, and continued evidence of his interest and concern is essential to the success of the program.

The **subject area specialists** on the local level include the local director of vocational education, the supervisor of industrial arts education, the supervisors of vocational education subjects, and the science specialists.

When public education systems first undertook the responsibility of providing shop and laboratory instruction for youth and adults, they assumed an obligation to insure an accident-free environment and a course of study which would include the teaching of safe practices. Although the **shop or laboratory teacher** bears the brunt of this responsibility, he must have the active support and cooperation of administrative and supervisory staffs. In the discharge of these responsibilities, the teacher must recognize the importance of certain preferred safety practices which should be employed to prevent accidents resulting in injury to students and/or damage to shop and laboratory equipment and building facilities.

STEPS IN ORGANIZING THE PROGRAM

A basic purpose of the Guide is to provide state and local educational administrators with specific suggestions for organizing an accident prevention program for their school shop and laboratory activities. Listed below are recommended steps which should be employed on both the state and local level.

State Program

1. **The state superintendent appoints the safety steering committee.** As was indicated previously, this committee should include those members of the superintendent's staff who supervise or coordinate school shop and/or laboratory programs. These staff members should then recommend to the superintendent the names of individuals to represent other interested state governmental agencies and state associations or organizations interested in promoting safety education in the public schools.

In his letters of appointment the superintendent would outline the objectives of the committee and set the time and place of the first meeting.

2. **The state steering committee formulates a preliminary plan of action.** Perhaps the most important step in such a plan would be the determination of the qualifications of the proposed safety specialist to be assigned to the superintendent's staff. If possible, the names of potential appointees should be submitted to the superintendent. The committee should also outline in some detail the duties and specific responsibilities of the safety specialist.

A preliminary action program should then be determined; it should include suggestions for: a) assessing the accident prevention situation in state school shops and laboratories; b) formulating the master plan of action; c) testing the plan; and d) reformulating the plan on the basis of test results.

3. **The safety specialist is employed.** As his first task, the specialist should complete an informal and personal visit with each member of the steering committee. The primary purpose of such visits would be to become acquainted with other members and to secure suggestions for carrying out the responsibilities of the position of safety specialist.

4. **Under the direction of the safety specialist, an analysis is made of the accident and injury situation in the state school shops and laboratories.** Such an analysis would entail careful planning by the specialist and close coordination with the subject area specialist of the superintendent's staff. A comprehensive report should be prepared and submitted to the superintendent, who will in turn transmit copies of the report to the steering committee.

5. **Under the coordination of the safety specialist a master plan for accident prevention is formulated by the steering committee.** A suggested format of such a plan will be found in Appendix A of this Guide.

The plan, when accepted by the chief state school officer and/or the state board of education, is discussed in detail with the local administrators who are conducting shop and laboratory activities. Suggestions are accepted and implemented whenever applicable.

6. **The state superintendent puts the master plan into action upon the approval of the state board of education.** The safety specialist is the key factor in this step, but it must be remembered that he is a member of the staff and not of the line organization. The implementation of this plan begins with the supervisors of the subject areas affected.

7. **The steering committee formulates a procedure for evaluating the plan of action.** Such a procedure would, of course, be developed under the guidance of the safety specialist and should include the use of specific measurement instruments.

8. **The superintendent of schools reformulates the plan of action on the basis of the evaluation results provided by the steering committee.** The testing program may result in major changes in the plan. However, if the organization of the program has been conducted in accordance with the prescribed principles, only periodic minor changes should be necessary for maximum effectiveness.

Local Program

1. **The local superintendent appoints the safety steering committee.** As was indicated previously, this committee should include those members of the superintendent's staff who supervise or coordinate school shop and/or laboratory programs. These staff members should then recommend to the superintendent the names of individuals who could represent other interested local govermental agencies and associations or organizations interested in promoting safety education in the local public schools.

In his letters of appointment the superintendent should outline the objectives of the committee and set the time and place of the first meeting.

2. **The steering committee formulates a preliminary plan of action.** Perhaps the most important step in such a plan would be the determination of the qualifications of the local safety specialist to be assigned to the superintendent's staff. If possible, the names of potential appointees should be submitted to the superintendent. The committee should also outline in some detail the duties and specific responsibilities of the safety specialist.

A preliminary action program should then be determined; it should include suggestions for: a) assessing the accident prevention situation in the local school shops and laboratories; b) for formulating the master plan of action; c) testing the plan; and d) reformulating the plan on the basis of test results.

3. **The safety specialist is employed.** As his first task he should complete an informal and personal visit with each member of the steering committee. The primary purpose of such visits would be to become acquainted with other members and to secure suggestions for carrying out the responsibilities of the position of safety specialist.

4. **Under the direction of the safety specialist an analysis is made of the accident and injury situation in the local school shops and laboratories.** Such an analysis will entail careful planning by the specialist and close coordination with the subject area specialists of the superintendent's staff. A comprehensive report should be prepared and submitted to the superintendent who will in turn transmit copies of the report to the steering committee.

5. **Under the coordination of the safety specialist a master local plan for accident prevention is formulated by the steering committee.** A suggested format of such a local plan will be found in Appendix B of this Guide. The plan when accepted by the local superintendent of schools or the board of education is discussed in detail with building principals who are conducting shop and laboratory activities. Suggestions are accepted and implemented whenever applicable.

6. **The local superintendent of schools puts the master plan into action upon the approval of his board of education.** The safety specialist is the key factor in this step, but it must be remembered that he is a member of the staff and not of the line organization. The implementation of the plan begins with the supervisors of the subject areas affected and the teachers who conduct the shop and laboratory activities.

7. **The steering committee formulates a procedure for evaluating the plan of action.** Such a procedure would, of course, be developed under the guidance of the safety specialist and should include the use of specific measurement instruments.

8. **The local superintendent reformulates the plan of action on the basis of the evaluation results provided by the steering committee.** The testing program may result in major changes in the plan. However, if the organization of the program has been conducted in accordance with the prescribed principles, only periodic minor changes should be necessary for maximum effectiveness.

POLICIES

An educational system that attempts to prevent accidents in school shops and laboratories without definite guiding policies—policies which are planned, publicized, and promoted—will find itself continuously rectifying mistakes which should never have been made. School administrators must establish and give publicity to its policies with respect to accident prevention.

Characteristics

A "policy" may be defined as a guide to action. Obviously, every directive from an administrator to his subordinates leads to action. The role of a policy is to guide each directive properly. Since directives lead to action it follows that there must be a policy basis for every directive and for every action which results.[2]

The word "policy" is generally used in an all-inclusive sense. As such it covers all guides to action. It forms the basis upon which decisions, whether major or minor, are made throughout the administrative structure.[2]

Kinds of Policies

Policies may result from the enactment of school codes. For example, the 1961 education code, State of California, division 10, article 7, section 13551 states that:

> No superintendent, principal, teacher, or other employee of a school district employed in a position requiring certification qualifications shall be held personally liable for the death of, or injury to, any pupil enrolled in any school of the district resulting from the participation of the pupil in any classroom or other activity to which he has been lawfully assigned as a pupil of the school unless negligence on the part of the employee is the proximate cause of the injury or death.

The administrative formulation of policies becomes necessary when the government, through legislative enactment or court action, passes a law, issues a directive, or makes a decision which must be accepted by the administration of an enterprise or institution. Because conformance is required, such policies are "imposed," and it becomes an executive responsibility to formulate the necessary statement of policies.

Policies may appear in the form of rules and regulations to insure the proper execution of directives and working plans. The following is an excerpt from the administrative guide of the Los Angeles city school district, Office of Board Services, and appears as coded reference 2325-7 under the heading of "Written Reports of Accidents".

> All accidents shall be reported in complete detail including accidents occurring to students before and after school, on school premises, and on the way to and from school. Form 74.43AR, "Pupil's Accident Report" shall be completed immediately by the teacher in charge or a person specified by the school principal. These reports must be made out in quadruplicate; three copies to be sent as soon as practicable after the accident to the insurance office, business division; the fourth copy to be retained by the principal. A follow-up report on Form 37.2, "Pupil Accident Follow-up Blank" shall be made in duplicate and both copies transmitted to the insurance office within ten days after the accident.

Policies may also appear in the form of procedures. For example, in the Administrative Guide of the Los Angeles city school districts the following procedure is established for accidents which occur in post-high school classes:

> The following procedures will be followed when serious accidents occur in post-high school industrial education evening classes . . . . Contact the school administrator or his representative immediately in the event of a serious accident: he will assume responsibility . . . . In the event the school administrator or his representative cannot be contacted, request another teacher to assume responsibility for your class until the emergency is over. If the substitute teacher does not have an industrial education credential in the subject area, instruct him to keep all power machines and equipment turned off. Give first aid to the pupil; then call a doctor for further instructions. In the event a doctor cannot be contacted, telephone the police emergency hospital to send an ambulance . . . . When a pupil is involved in a serious accident in a post-high school industrial education class, forward his safety test along with a complete accident report to the Insurance Section, Business Division.

When a policy is of a routine or less-important character, it is often convenient to state it in the form of a standing order. The "no smoking" sign in a school facility is obviously a notice of a policy to reduce the hazard of fire rather than to control the habits of students, so it is convenient to use the naturally-derived and commonly-understood command that simply prohibits smoking in certain places.

Policy may spell out the school administrator's attitude toward safety and give some indication how the accident prevention program will operate. Points to be covered in such a policy might include:

1. A statement to the effect that safety shall be a prime requisite in all shop and laboratory activities.

2. That the school administration will provide mechanical and physical safeguards in keeping with recognized standards.

3. The policy with respect to requiring personal protective equipment where the nature of the work requires it.

4. The policy with respect to compliance with shop and laboratory rules.

5. The establishment of a safety committee or committees and how they will function.

6. Other pertinent policy matters depending upon local conditions.

Written Policies

The decision to formulate policies in writing depends upon several factors: the large organization generally produces written policies and preserves them, and makes sure that all departments and personnel concerned have reproduced copies. Some school administrators favor the formulation of policies in writing, regardless of the size of the institution. The more legal or controversial the problems, especially as they apply to shop or laboratory injuries, the greater is the probability that the needed policies will be formulated in writing. Some policies are written for legal reasons, while others are written to prevent possible controversy.

Administrative policies are often reduced to writing at the time they are formulated. This is usually done by means of approval or disapproval of the recommendations of a report; by preparing minutes of a conference; by writing a short note, memorandum, or letter on the subject; or by filing correspondence and hand written notes.

School administrators should maintain a complete and accurate file of policies. Such a file has a value as a reference or recording system rather than as an actual basis for operation. An important phase of executive skill is the accummulation through the years of a memory of decided policy. The better the memory, the more likely is the administrator going to be able to meet new conditions with new and aggressive policies. The successful administrator uses policy as a tool, not a hampering administrative procedure.

RESPONSIBILITY

Accident prevention programs or activities in school shops and laboratories must have leadership and guidance. The three basic units of leadership are the administrator, the safety specialist or director, and the teacher.

The Administrator

The individual school is the central unit of an educational enterprise; therefore, the building principal is likely to be the administrator who is most directly concerned with the school shop safety program. If a specialized supervisor or department head functions under the principal and works directly with the teachers, some of the responsibilities for the safety program may be delegated to him. The supervisor or head teacher of industrial arts may be responsible for the safety program in industrial arts. The head of the school department of vocational electricity and electronics may be responsible for a safety program in the electrical and electronics shops and laboratories.[3]

The following functions are generally considered the responsibility of the school administrator in a comprehensive shop safety education program:

1. Secure support from and maintain liaison with top school system administration.
    a. Secure approval for the safety education program.
    b. Secure adequate budgetary support.
    c. Expedite building and structural changes necessary for safe operation.
    d. Arrange for procurement of safety equipment.
    e. Make formal reports of accidents to higher administrative authority.
2. Provide leadership in planning the program.
    a. Initiate a specific program of safety education.
    b. Promote school-wide attitudes toward accident prevention.
    c. Secure enthusiastic support of teachers.
    d. Set up in-service training in accident prevention for teachers.
3. Secure action on a program of safety education.
    a. Check periodically to make sure an adopted safety education program is in effect.
    b. Observe teachers for assurance that safety instruction is a functioning part of the course of study.
    c. Stimulate the discovery, analysis, and prompt correction of unsafe conditions or practices.
    d. Support teachers in enforcing safety regulations.
    e. Receive and review accident reports.
    f. Establish procedures for investigating and analyzing accidents.
4. Provide safe facilities and services.
    a. Report unsafe structural conditions to higher authority.
    b. Plan with teachers for the removal of unsafe structural conditions and other hazards, and the installation of safety devices.

5. Secure cooperation of outside personnel and agencies.
   - a. Assist the teachers in locating community personnel and services which will be helpful in the safety program.
   - b. Encourage outside individuals to assist in the school shop safety program.
   - c. Inform the public regularly about the safety education program.[3]

The Safety Specialist

Whatever the title, the safety specialist will be responsible for solving two principal problems: how to remove physical hazards from the school plant; and how to substitute safe practices for unsafe practices of students and personnel. The duties and responsibilities of the safety specialist ordinarily include the following:[4]

1. Formulating, administering, and making necessary changes in the accident prevention program.
2. Submitting directly to the school administrator regular monthly, weekly, or daily reports on the status of the accident prevention program.
3. Acting in an advisory capacity on all matters pertaining to accident prevention as required for the guidance of the school administrator or the safety committee.
4. Maintaining the accident record system, making necessary reports, making personal investigation of fatal, serious and potentially serious accidents, and checking corrective action taken by teachers or other personnel to eliminate accident causes.
5. Supervising or closely cooperating with subject-matter supervisors in the safety training of students.
6. Making personal inspections for the purpose of discovering and correcting unsafe conditions or unsafe work practices before they cause accidents.
7. Maintaining professional contacts outside of the school environment to exchange information with others and to keep the accident prevention program up to date.
8. Making certain that federal, state, or local laws, ordinances, or orders, bearing on safety are complied with.
9. Securing necessary help or advice from state labor departments or insurance carriers on matters pertaining to the safety and health of students or other school personnel.
10. Starting and continuing activities that stimulate and maintain teacher and student interest in accident prevention.

11. Controlling or supervising fire prevention and fire-fighting activities where they are not the responsibility of specific departments.

12. Setting standards for safety equipment to be used by school personnel.

The Teacher

The major responsibility for shop or laboratory safety instruction in accident prevention falls on the teacher. If a number of teachers work in a building under a supervisor or a department head, the latter may carry some direct responsibility. The following are generally considered the responsibilities of the teacher in a comprehensive accident prevention program in school shops and laboratories.

1. Incorporate safety instruction in the course of study.

2. Give instruction on hazards and accident prevention specific to the particular school shop or laboratory.

3. Give instruction and promote activities which will lead to accident prevention in future employment.

4. Foster student cooperation in accident prevention.

5. Follow all safety practices personally.

6. Keep informed about modern and accepted safe practices in the subject field.

7. Revise shop or laboratory facilities to provide for optimum safety conditions. Give special attention to a) layout, b) utilities and building services, c) equipment and tools, d) storage and handling of materials.

8. Carry out recommendations of the administrator for improving safety instruction.

9. Devise and enforce safe housekeeping procedures.

10. Provide for use and maintenance of necessary personal protective equipment.

11. Develop specific safe practices and regulations.

12. Make recommendations to administrators for improving environmental safety conditions.

THE SAFETY COMMITTEE

An important element in the organizational structure for furthering the cause of accident prevention in school shops and laboratories is the safety committee. The basic purposes of all such committees are the creation and maintenance of an active interest in safety and to reduce accidents. Specifically, safety committees are organized to:

1. Arouse and maintain the interest of school administrators, supervisors, and teachers and to help them understand that safety is everybody's business.

2. Arouse and maintain the interest of students and convince them that they play an essential role in the prevention of accidents to themselves and others.

3. Make safety activities an integral part of operating policies and methods and a function of operation.

4. Provide an opportunity for free discussion of accident problems and preventive measures.

5. Discuss and formulate accident prevention policies and recommend their adoption by school administrators.

6. Discover unsafe conditions and practices and determine remedies.

7. Work to obtain results by having its administration-approved recommendations put into practice.

Policies and Procedures

When a safety committee is formed, specific policies and procedures should be set forth in writing and should cover at least the:

1. Scope of the committee's activity.

2. Extent of the committee's authority.

3. Procedure as to:

    a. Time and place of meetings.

    b. Frequency of meetings.

    c. Order of business.

    d. Records to keep.

    e. Implementation of committee recommendations.

    f. Attendance requirements.

Types of Safety Committees

Among the types of safety committees recommended for an effective program of accident prevention in school shops and laboratories are the 1) state safety steering committee, 2) local safety steering committee and 3) shop or laboratory safety committee. State and local steering committees have been discussed earlier in this chapter.

Shop or Laboratory Safety Committees

The school should organize student safety committees either on a school-wide basis or on a shop basis. If the latter plan is adopted, more students will have the opportunity to serve on such committees and more educational benefits will result. The committee should follow as closely as possible the pattern of safety committees in local industries. Such school shop committees offer a broad educational background to the student. In addition to providing essential safety education they offer training in English, speech, health, and parliamentary procedure.

The size of the shop committee can vary with the size of the class. Most shop safety committees consist of five students, with some persons retiring each month to make it possible for all students to have an opportunity to serve part-time as members of the committee. However, the entire committee should not be changed at one time, but rather substitutions made so that a part of the committee consists of old members. The committee can be chosen by election of the students with the requirement that the retiring committee members may not be reelected. This procedure encourages democratic action and gives all class members an opportunity to gain experience in serving on the safety committee. The committee should elect a chairman and a secretary. Ex-officio members of the safety committee are the instructor and the current student safety foreman.

Meetings should be held at least once every two weeks in order that the students may have frequent opportunity to participate in the safety discussions. Meetings of one-half to three-quarters of an hour are desirable. Long meetings should be avoided and meetings should be kept lively.

The general conduct of the meetings in the school shop can be patterned as follows:

1. Roll call of members.

2. Reading and approval of minutes of last meeting.

3. Unfinished business and report on completion of recommendations at last meeting.

4. Report of special committees–including inspection and accident investigation reports.

5. Recommendations in regard to unsafe conditions and prevention of future accidents.

6. Safety suggestions received.

7. Posting of bulletins.

8. Revision of shop rules.

9. Discussion of safety in the shop.

10. Special features, such as an outside speaker.

11. Adjournment.

The duties of the school shop safety committee might include the following:

1. Investigate and report on each accident with corrective action established to prevent recurrences.

2. Develop and revise shop safety recommendations.

3. Check the shop for accident hazards and unsafe practices.

4. Recommend changes or additions to eliminate unsafe conditions.

5. Promote first aid training in the shop.

6. Develop the shop accident prevention program.

7. Conduct safety education activities in the shop.

8. Plan and effect safety interest methods such as demonstrations, contests, and displays.

The minute of each safety committee meeting should be posted on a safety bulletin board so that all students in the shop can read them and be informed of the current activities of the committee. Such activities if carried on in the school shops will better prepare the student to participate as a safe worker in industry.

COOPERATING AGENCIES

There is a wide base of resources which the school administrator, the supervisor, and the shop teacher can utilize in conducting an accident prevention program for school shops and laboratories. Particularly in the technical aspects of safety, the teacher may need specialized information as well as up to date information which may not yet be in published form. For these reasons, therefore, a familiarity with the publications of the national, state, and local agencies engaged in promoting industrial safety is indispensable to an individual responsible for accident prevention in school shops and laboratories. Some of these organizations are governmental, some are private, some are non-private agencies, while others are connected with insurance companies or associations. A directory of such agencies is included in Appendix E of this Guide. For a more comprehensive presentation of national, state, and local agencies which may be employed in the organization and administration of an accident prevention program, educators should refer to the *Accident Prevention Manual for Shop Teachers,* a professional publication of the National Association of Industrial Teacher Educators, published by The American Technical Society of Chicago.[6]

REFERENCES

1. U.S. Department of Health, Education, and Welfare, Office of Education, *School Shop Safety,* OE-84003, Circular No. 609.

2. Industrial College of the Armed Forces, *Emergency Management of the National Economy,* Volume I (New London, Conn.: National Foremen's Institute, Inc. 1950) p. 59.

3. William A. Williams (ed.), *Accident Prevention Manual for Shop Teachers,* (Chicago: American Technical Society, 1963) pp. 49-51.

4. National Safety Council, *Accident Prevention Manual for Industrial Operations,* 5th edition, (Chicago: National Safety Council, 1964) pp. 2-3 and 2-5.

5. New York State Education Department, *Shop Safety Education,* (Albany: New York State Education Department, 1949). pp. 241-244.

6. William A. Williams, *op. cit.*

CHAPTER 3

ADMINISTERING THE ACCIDENT PREVENTION PROGRAM

In general there are five main steps which must be taken for the effective accomplishment of any administrative activity. Earl Strong[1] refers to these steps as the administrative skills of planning, organizing, motivating, directing, and controlling. Administration of the accident prevention program in school shops and laboratories includes: 1) **Planning**–the determination of what to do, how to do it, when to do it, and who is to do it; 2) **Organizing**–the development of an accident prevention structure which will accomplish the planned objectives, fix the responsibilities, establish relationships, assure coordination, assure control, determine group related functions, and document the organization; 3) **Motivating**–the application of incentives in order to create and maintain behavior conducive to the attainment of accident prevention objectives; 4) **Directing** –the provision for the guidance and supervision needed by individuals to carry out their assigned responsibilities; 5) **Controlling**–the comparison of actual and desired performance through the application of evaluated criteria; taking necessary corrective action to prevent unfavorable deviations from established plans.

This chapter deals with the principles of administration, the exercise of authority, and the auditing, reporting, and documentation of an accident prevention program.

PRINCIPLES OF ADMINISTRATION

The effective implementation of administrative skills requires the application of certain principles of administration. Such principles can 1) improve administrative efficiency, 2) help solve the administrator's problems, 3) crystallize the nature of the administration, 4) simplify the training of administrators and supervisors, and 5) improve channeling of continued research.

There is no limit to the possible number of principles concerning administration. Every administrative guideline or device that will strengthen an organization or facilitate its operation deserves a place among the principles of administration, so long as experience proves it to be worthy of the position. Certain fundamental principles, however, serve as a foundation to insure sound administration. These principles are concerned with the general area of administration and will not be presented under the specific skills of planning, organizing, motivating, directing, and controlling.

1. **Allowances are made for changing conditions and for internal adjustments to meet such changes.** Flexibility should be a major consideration in the selection of plans, organization, and operations. The costs and hazards of such flexibility, however, must be weighed against its advantages. Public school administrators should consider accident prevention as a basic part of their operation, rather than as an afterthought, and safety precautions should be regarded as an integral part of any modification or addition to school shops and laboratories.

2. **Research is employed to obtain accurate and complete facts as the basis of efficient administration.** Research is concerned with the systematic evaluation and analysis of materials and methods for the purpose of obtaining information that will be of value in assisting the organization to achieve its basic objective.[2]

Administration must proceed on the basis of facts derived from research or investigation aimed at scientific precision and impartiality. Safety specialists have decried the lack of studies, surveys, statistics, data, and organized research in the area of school shop and laboratory safety. For example, information is needed about a) the extent of participation of educators in safety education, b) the causes, frequency, and severity of accidents in school shops and laboratories, and c) the extent and nature of safety program materials needed for state and local use. School administrators can provide the leadership in encouraging research and special studies in the many aspects of safety education and accident prevention. Some suggested activities include the following:

a. Compile information from all possible sources and interpret it in terms of needed shop and laboratory safety education research.

b. Collect information concerning accident experience of students, teachers, and other personnel in school shops and laboratories.

c. Identify shop and laboratory safety education research from available information and program-operation data.

d. Define the elements in teacher education programs that develop teachers who can prepare individuals to enter the work force and carry out their duties safely.

e. Recommend priorities for school, shop, and laboratory safety research and inititate action to accomplish the needed research.

f. Stimulate experimental safety education programs to determine the effectiveness of certain learning activities and safety practices.

g. Provide for a continuing comparative analysis of safety education and its benefits to workers in small establishments as compared to large establishments.

3. **Effective control requires standards of performance which are objective, accurate, and suitable.** Even the best administrator cannot help being influenced by personal factors, and actual performance can sometimes be camouflaged by a dull or sparkling personality. Good standards of performance applied objectively will ensure job evaluation on the quality of performance rather than personality of the worker, and they will be appreciated by the worker as being fair and reasonable.

The school administrator should follow the example of industry and employ its standards for appraising the effectiveness of accident prevention. The disabling injury frequency formula is one of the devices used as a measure of effectiveness. This formula is expressed as follows:

$$\textit{Frequency Rate} = \frac{\text{No. injuries x 1,000,000}}{\text{No. man hours exposure}}$$

It thus provides the number of disabling injuries per million man hours of work exposure. In 1965 this frequency rate for all industries combined, which report voluntarily to the National Safety Council, was 6.53. In the school shop or laboratory situation, the number of student hours worked would be substituted for the total number of man hours worked in industry.

The severity of accidental injuries provides an additional method of appraisal. It is expressed as follows:

$$\textit{Severity Rate} = \frac{\text{No. days lost x 1,000,000}}{\text{No. man hours exposure}}$$

It thus provides the number of days (work days, holidays, and weekends) lost per million man hours of work exposure. The number of hours spent by the student in school shops and laboratories would be substituted for the number of hours of exposure (work) in industry. In 1965 this severity rate reported to the National Safety Council for all industries combined was 695. Injury frequency and severity rates should be employed on a system-wide basis rather than on a shop-to-shop basis. Details of school accident reporting procedures are given in Chapter 4 of this Guide.

4. **The acquisition, filing, storing, and retrieval of records is a vital necessity to all organization, whether they be large or small.** Safety records sufficiently detailed and analyzed can be the lifeblood of accident prevention efforts and can contribute to the efficiency of accident control. Accident records can serve as a valuable tool in all safety programs, but the mere completion and filing of records is not enough; they must be retrieved and used in every beneficial way possible. It is recognized that while most school administrators have the desire to prevent accidents in shops and laboratories, they must be motivated to take safety action, or else normal administrative pressure may cause them to regard safety as something which can be taken care of some day if they can get around to it. Records can be used as tools to motivate educators to take action now and not at a later date.

5. **Direction is facilitated when all communications are framed and transmitted in such ways as to support the objectives of the organization.** The major methods of communicating (oral and written) used in an organization and the corresponding skills that need to be developed can be listed as follows:[3]

Communication	**Skill Required**
Talks to groups	Speaking to groups
Informal contacts– conversation and telephone	Speaking with and listening to others
Interviews	Interpersonal relations
Conferences and meetings	Leading and participating in conferences
Instructing	Telling and showing
Letters	Writing
Memorandums	Writing
Bulletins and manuals	Reading
Reports	Writing and reading
Bulletin boards	Reading

The following guides also presented by Strong[4] should assist school administrators in improving listening as well as speaking ability:

As a Speaker

a. Plan your remarks in terms of listener reaction. Have a purpose.

b. Organize your main thoughts clearly.

c. Keep your specific purpose in mind at all times.

d. Be listener-centered, not self-centered.

e. Avoid being autocratic or dogmatic.

f. Use sufficient facts, evidence, and other proof.

g. Consider possible listener prejudices and attitudes.

h. If a change is proposed 1) tell why, 2) show advantages, 3) seek listener's suggestions, 4) be clear to the listener, and 5) proceed slowly.

i. Be enthusiastic and projective in your manner.

j. Look the listener in the eye.

k. Use language he understands.

As a Listener

a. Anticipate the situation and the message of the speaker.

b. Look for main points of the speaker.

c. Analyze the speaker's purpose.

d. Be speaker-centered, not self-centered.

e. Consider speaker's right to be autocratic if in a superior position.

f. Weigh speaker's facts and relate evidence to his conclusions.

g. Suppress your prejudices as you try to understand the speaker's position.

h. Be open minded to new ideas: 1) find out why, 2) weigh the advantages, 3) make suggestions, 4) understand the speaker, and 5) think before you reply.

i. Be physically alert and attentive.

j. Look the speaker in the eye.

k. Analyze language in terms of what the speaker means.

Effective communication in an accident prevention program can influence action and effect change. Today's educational administrator must make every effort to apply the methods and techniques of communication to the safety objectives of his shop and laboratory programs.

6. **A strong and forthright leadership is maintained through an effective training program.** Providing effective leadership is one thing, but its maintenance, once established, is quite another. Perhaps the major problem in teaching leadership, according to Koontz and O'Donnell,[5] is that, "It is a dynamic and personal process–dynamic in the sense that techniques vary with circumstances and with the people involved, and personal in the sense that interpersonal influence is exercised."

It is certainly true that some leaders are "born" to the task, but this is not to say that the qualities of leadership cannot be acquired through education and training. High on the list of these qualities is "knowledge of the subject." The knowledge and philosophy of accident prevention is not "just common sense," as some slogans proclaim. It is a specialized body of information accumulated over a period of many years which has been marked by greatly decreased injury rates in industry. Administrators and supervisors of all levels who undertake the responsibility for accident prevention need the benefit of that knowledge, and it is the job of the safety specialist to help them gain whatever information is available to make their safety efforts more productive. The most direct way to develop desired attitudes and to impart to school administrators and supervisors the necessary information about accident prevention in school shops and laboratories is through courses of instruction. Chapter 5 details such a program of instruction.

7. **The human factor must be dealt with in every aspect of administration.** An administrator is concerned with people; the more proficient he becomes in understanding them and their problems, the more proficient he becomes in directing his organization. Much of the success of an accident prevention program depends upon its acceptance by those to who it is directed. The National Safety Council emphasizes the following psychological factors in safety:[6]

> *Consider Individual differences,* one of the ever-existent problems within industry, are seen constantly. Yet within the framework of differences in people are factors that are common to all and therefore useful in dealing with work groups.
>
> *Understand the motivations* of people. To want something is to be motivated, but not to want something also requires motivation. To use a safety device to protect one's fingers from a saw is perhaps indicative of motivation for safe practices, but the desire to ignore a safety device because it might increase production is also a motivated matter. Conflicting motivations should also be considered in any attempt to understand human relations.
>
> *Emotion* is another important topic. Humans frequently act at the emotional level. While emotions can be constructive at times, they can also be destructive—working to the detriment of the individual and the safety program. Emotion can so disrupt or confuse the thought process that an individual will not do what he knows he should do, but rather do the opposite merely because of the way he feels.
>
> *Attitudes* are so closely allied to emotions that some people consider them as pure emotional responses. Industry has recognized the effect that attitudes can have on production, plant morale, turnover, absenteeism, plant safety and the like. As a result management has spent much time and money to determine the attitudes of workers. Measuring, developing, and changing attitudes constitute a major problem for personnel men and psychologists—one of extreme importance to the safety man.
>
> *Learning processes.* Learning has gone on from the first day of birth and in all of the topics previously mentioned it has played a major role. One cannot understand motivation, attitudes, emotion, or even individual differences without some consideration of the learning process involved in bringing them about.
>
> Individual differences, motivation, emotions, attitudes, and learning are bound up with accidents. The safety man must work with them directly. (The problem of motivation will be presented in some detail later in this chapter.)

8. **Planning is influenced by the rate and nature of technological change.** The administrator of course has little or no control over an external flexibility as unwieldy as technological development. Technology does change and it changes rapidly with one new development producing another. School administrators know that "education must become the process which will enable

the individual to withstand the inevitable changes which will occur in the relationship between what he learns and what he will be called upon to do in the world of work."[7] Administrative planning must be geared to such changes. Safety education must keep abreast of the changing technology.

An *ad hoc* committee of the U.S. Office of Education[8] developed the following suggestions for educators in their effort to keep accident prevention in school shops and laboratories adjusted to the changing industrial technology:

a. Utilize available safety resources, especially those agencies having the competency, concern, and staff to provide the applicable assistance. Liaison should be established with appropriate individuals and associations.

b. Provide the necessary leadership through effective organizational patterns. Safety education specialists should be employed on the federal, state, and local levels.

c. Identify effective safety programs and communicate relevant information to those who can use it effectively (*e.g.*, vocational and industrial arts teacher-educators.)

d. Disseminate available safety information to shop and laboratory teachers and supervisors through newsletters, bulletins, periodicals, and other communications media.

e. Provide for continuing research and special studies through existing staff members, research specialists, and graduate students on college campuses.

f. Encourage continuing safety inspections of school facilities and procedures to insure a safe environment for students and teachers alike. Inspections may be made by representatives of industrial commissions, safety engineers, inspectors from state departments of labor and industry, state or local fire inspectors, student safety committees, or qualified school personnel.

g. Encourage the development of a modified form of workmen's compensation involving pupil remuneration as a possible solution to the problem of liability associated with school-related injuries.

h. Provide for a system of trainee selection based on ability to meet the physical requirements of the entry occupation (*e.g.* vision and hearing).

9. **Plans can best be structured and coordinated when those responsible for planning have a sound rationale for their area of planning.** This principle indicates that those who plan must proceed from consistent premises. An example is the following rationale employed by the *ad hoc* committee of the U.S. Office of Education[9] for their "total plan of action for improving school, shop, and laboratory safety at the federal, state, and local levels":

a. Industry and labor expect entry workers to be oriented from a health and safety standpoint; an evaluation of industry and labor needs is required.

b. Industry and labor expect schools to assist in upgrading adults with regard to the health and safety requirements of business and industry.

c. Schools are the logical agency for developing the understanding of the special problem of the health and safety of disadvantaged individuals who are entering or are in the labor market (or should be in the labor market).

d. All students should have the safety attitude that carries over into other activities; safety education is the "trigger" for general attitude development.

e. Emphasis at the national level is needed to improve school management's attitude toward safety education.

f. There is need for increased emphasis on safety education and its administration at the state and local levels.

g. There is a need for a better understanding of automation and technical development as applied to industrial accident prevention and safety education.

h. There is a need for a better transition for youth from school to employment in business and industry; safety education in school must be reinforced.

i. The shorter work-life period will increase the value of every individual in the work force.

j. Industry cannot afford losses due to accidents to new employees; margins of profit, time elements, etc., are limited and are being reduced.

k. Procedures and criteria for the selection of new workers are becoming more critical; selective screening includes the elements of safety attitudes and accident experiences.

l. School shop safety has implications for out-of-school living as well as preventing injury in the teaching-learning situation.

m. State and local communities should be made aware of the need for safety education.

n. The American Vocational Association has officially recommended that the Division of Vocational and Technical Education of the United States Office of Education provide leadership and material assistance for the development and implementation of an effective nation-wide program of accident prevention and safety education in school shops and laboratories.

Another example of the application of this principle is the following set of premises suggested at the 1964 President's Conference on Occupational Safety[10] for mobilizing leadership for a safety breakthrough in education:

a. The home environment and family concern for safety are prerequisites for developing proper attitudes toward safety.

b. Occupational training, incorporating safety education, should be provided where needed for all youth and adults regardless of their varying talents and socio-economic background.

c. There are no shortcuts in the performance of everyday skilled tasks. Each operation properly performed contributes to safe living.

d. Youth are influenced as much by example as by instruction, which places responsibility upon parents, the community, the school, industry, and labor to make sure that the examples are appropriate for youth to follow.

e. Occupational information essential to safety education should come from business and industry.

f. The preparation and upgrading of teachers should include their participation in seminars and consulting services made available by business and industry.

g. The technological competencies of business and industry should be utilized in the establishment and the operation of all levels of occupational training.

h. Local safety councils, representing a cross-section of citizens groups, provide the best means for coordinated efforts in assisting the school safety education program.

i. All communications media should be utilized to inform the public about the school's safety education program.

10. **Each individual within an organization must make efficient and effective contributions to the achievement of group goals.** Under the heading of **PRINCIPLE OF EFFICIENCY,** Koontz and O'Donnell[11] emphasize that, "It is recognized that the individuals who are employed in enterprise have objectives to accomplish which are not only different from each other but are also different from those of the firm. It is of paramount importance that the latter be accomplished for this is the sole reason for the organized activity. As a consequence there must be a mutual rapport between individual and enterprise goals–achieving certain individual goals can and does further the best interest of the firm and it is these for which subordinates are rewarded. Furthermore, it is vital that each individual make an effective contribution to enterprise goals because this is the basis of overall efficiency."

One of the driving human factors is an individual's desire to feel that he is a part of his group or organization. This factor applies to an accident prevention program in school shops and laboratories. Many such programs fail because the teachers and students have not been made to feel that "it is their program" and that they can contribute as well as benefit. Stated another way, the program fails because it lacks teacher and student involvement and interest. Chapter 4 suggests ways and means for all individuals to contribute to the achievement of the objectives of accident prevention.

11. **Policy making and policy adjusting are combined at the outset.** This might be referred to as a "principle of coordination." Coordination must take place in the early stages of planning and

policy making rather than *after* operations begin. The following example illustrates a lack of coordination and the confusion that results. A school administrator specifies the sterilization of eye protective devices after each use without consulting the teaching staff or waiting until the proper materials, equipment, and training can be provided. The cry "Why doesn't someone tell me these things?" is a natural response in such situations.

In their presentation of the techniques of coordination, Koontz and O'Donnell[12] state, "The oldest as well as the most important device for achieving coordination is the supervisor. His chief duty to his own superior is to see that his subordinates are achieving a high quality of coordinated effort among themselves and in their relationships with other groups. This does not mean that supervisors directly coordinate the work of their subordinates, but that they employ directional devices, teach principles of coordination, illustrate their application, and apply tests to determine the quality of synchronized effort."

The school administration can spell out exactly what its policy is with respect to accident prevention in shops and laboratories, but unless the policy is adhered to and implemented at the outset, and adjusted as required, it will have little or no effect on injury prevention. Adherence and implementation are the responsibilities of the teacher. The discharge of these responsibilities is the basis for the often repeated statement, "The teacher is the key element in every successful safety program." It is necessary, therefore, that the teacher know the established policies, that he be able to interpret them and apply them in particular situations, with full administrative support, and that he translate the policies into action. Daily, sometimes hourly, the teacher is called upon to make decisions which may involve interpretation of administrative policy. Questions involving what safety devices should be used, what personal protective equipment should be provided for a certain job, what to do when a student disobeys safety instruction, how to treat suggestions from the safety committee, or how to find out the degree of hazard of a new solvent, are the kinds of questions that involve some phase of safety. The answers to these questions are a gauge of the teacher's ability to interpret and implement the safety policy.

12. **The best practices for recurring activities are standardized.** Standardization, a special element of control, is the act of determining and adopting the best method of carrying out a recurring activity. However, standardization does not preclude further improvement. On the contrary, it provides a tangible basis for the further orderly development by crystallizing thought and procedure. The advantages of standardization include the following:

a. Organization can provide the fixed system of administration. Standard procedures furnish efficient motivation for such a system.

b. There is almost always one best way of accomplishing a desired result. Determination and adoption of the best way saves time and effort.

c. Standard procedures reduce the necessity for daily decisions as to work method.

d. Errors are minimized by substituting specific instructions for general policies.

e. An objective device for evaluating performances is provided through the comparison of actual performance with the established standard.

f. Training and coordination are facilitated.

The following steps are suggested to standardize administrative functions:

a. Note those activities which are of a recurring nature.

b. Analyze one activity, or group of closely related activities, at a time.

c. Determine the best procedure for performing the activity analyzed.

d. Test the selected procedure and revise and retest as necessary.

e. Adopt the tested procedure.

f. Document the adopted procedure.

Standardization in an accident prevention program for school shops and laboratories can involve accident reporting, forms and procedures, safety inspection forms and procedures, safety rules and regulations, color coding, safety practices, hazard analysis, facility design and layout, machine guarding, equipment maintenance, etc.

EXERCISE OF AUTHORITY

Authority is the right to control, command, or determine. In the job of the administrator, authority is the power to direct others; it is the right to require certain kinds of actions in order to make organization and administration possible. "Authority then is the cohesive force in enterprise; the force that sets in motion the integrated activities of subordinates. Without authority anarchy would result."[13] A teacher derives authority for control over students from the legal phrase *in loco parentis,* which means "in place of the parent." Under this concept teachers assume some of the rights and duties of the parent. "This principle has evolved to the point where the school now derives its authority from the whole body of organized society. Strict discipline must be enforced consistent with accepted methods and techniques of good teaching and in keeping with school policy."[14]

Authority and responsibility are inseparable. Responsibility is an obligation which is owed to one's superior and must be matched by the authority necessary to carry out such an obligation. Responsibility may be a continuing obligation, or it may be fulfilled by a single action. The relationship between a school superintendent and his director of vocational education is a continuing obligation, but, on the other hand, the superintendent may employ a consulting safety engineer for an accident prevention study whose obligation will cease when the assignment is completed.

The administrator exercises his authority as he carries out his functions of planning, organizing, motivating, directing, and controlling. He cannot be an administrator without subordinates. He plans, organizes, motivates, directs, and controls through subordinates. The school superintendent administers his accident prevention in school shops and laboratories through his subordi-

.nates and expects them to exercise their delegated authority through supervision, enforcement, preventive action, corrective action, and the techniques of motivation.

Supervision

Supervision is overseeing–overseeing for the purpose of providing the necessary guidance that an individual needs to carry out his assigned responsibilities. Education supervision is for the purpose of improvement: the superintendent to improve his organizations, procedures, and practices; the principal to improve the instructional skills of his teaching staff; the teacher to improve the learning skills of his students. In accident prevention supervision is also for the purpose of improvement: the superintendent to improve the top level endorsement of the accident prevention program; the principal to improve the accident prevention practices of his teaching staff; the teacher to improve: 1) the working conditions and safe practices in the shop or laboratory, 2) the safety instruction for his students, 3) the attitude of his students toward accident prevention, and 4) the adherence of the students to established safety rules and regulations.

A primary objective of instruction in accident prevention in school shops is the development of accident-free workers for our industrial and agricultural communities. This objective can best be accomplished through individuals who individually and collectively reflect characteristics such as initiative, cooperation, efficiency, responsibility, high morale, and a capacity for growth and development. The responsibility for developing and reinforcing these characteristics rests with effective leadership and the application of sound techniques of supervision.

Enforcement

The National Safety Council says that the enforcement of safety rules is actually a matter of education.[15] To set a good example for safety education in school shops and laboratories, school administrators, supervisors, and teachers must believe in safety rules and must conscientiously observe and enforce them. There can be no exceptions to safe practice, including the teacher himself, and this requires constant vigilance on the part of the teacher. By enforcing safety rules and regulations the teacher exercises his authority and as a result builds safety attitudes and develops student safety habits which are employed automatically and unemotionally. All safety rules should be continuously enforced.

Administering reprimands for the violation of safety rules demands tact and good judgment. This duty should be performed by someone in authority who commands respect and who is sympathetic without being lax. In school shops and laboratories this should be the teacher; however, a public reprimand should be administered only when there is a group educational purpose to be served. When the teacher feels that the student is deliberately disobeying rules and through unsafe acts endangers his own life and the lives of others, prompt and firm action is justified. It is far better to use extreme measures than to allow accidents to happen because of laxness in the enforcement of established rules.

The problem of teachers disobeying safety rules and regulations is, of course, a particularly serious matter. Because education oftens succeeds where discipline fails, it is usually used when supervisors find violations by teachers, although some administrators, in addition to instruction, give a warning on the first violation. The second offense may be followed by a stronger warning. The third offense might result in a recommendation to the school board that the offending teacher be discharged.

Ramp and Johnson[16] have a particular philosophy regarding the enforcement of safety rules and regulations in the school shop. They state, "While some have recommended that students be allowed to participate in the enforcement of rules, it seems a wiser policy to reserve this duty for the teacher. This is especially true where punishment for infractions of rules may be necessary. Immediate correction of student action which violates safety standards is required if regulations are to be respected. Otherwise the rule will cease to exist. If punishment is warranted in order to impress the student with the gravity of his act, it should be of such nature that he and his classmates will see the justice in it. A common practice in these cases is withdrawal of shop privileges or prohibiting the use of certain equipment for a period of time. Rules that are not respected are worse than no rules, and enforcement that is not consistent is worse than none at all. The negative impact of inconsistent enforcement on the developing attitudes of young people is of too great a consequence to allow this condition to prevail."

Preventive Action

The exercise of authority through preventive action is the anticipation of an unwanted occurrence and the subsequent application of preventive measures. In the realm of accident prevention in school shops and laboratories, this means the organization and administration of an effective safety program with its four elements of 1) top administrative leadership, 2) a safe and healthful environment in which to work, 3) proper training and supervision, and 4) student participation and interest.

Top Administrative Leadership

All successful safety programs have active aggressive leadership at the administrative level. Where an active top-level endorsement of an accident prevention program exists, it cannot help but develop the right kind of safety attitude which will filter down through the various levels of supervision and instruction to its ultimate destination–the student in the shop or at the machine. The areas of direct administrative action have been discussed earlier in this publication and include: 1) the establishment of policy, 2) the delegation of authority, and 3) the assessment of progress.

A Safe and Healthful Place to Work

A safe and healthy physical environment is the foundation on which every successful safety program is built. To provide such an environment or work place requires control–the exercise of authority. Such control is the administrator's responsibility, and the organization and administration of every safety program is predicated on the efforts of the administration to provide a safe work place.

The control of the physical environment begins with a complete survey of the school plant. In making a survey, consideration should be given to the following factors:[17]

1. The condition of the building and facilities.

2. The layout of the work place with respect to the location and guarding of machines and equipment.

3. The access to and from the work place and the adequacy of aisles and storage areas.

4. The flow of materials through the shop, including the disposal of scrap.

5. The handling of materials.

6. The control of hazardous materials.

7. The control of hazardous processes.

8. Lighting, noise, ventilation, heat and humidity, vibration, and other related environmental exposures.

Familiarity with the school plan may mean that hazards go unrecognized. It may be advisable in making the survey to get assistance from someone less familiar with the school plant, such as a professional safety engineer or a local safety inspector. It may be helpful for the teacher in one shop to inspect another teacher's shop to spot hazards which are overlooked because of long association with them. Following the initial survey a complete list should be made of all physical changes necessary. Periodic follow-up surveys of the plant should be made to check on action taken and to make certain that physical conditions are maintained safely.

Proper Training and Supervision

For almost every accident there are two contributing causes–an unsafe physical environment and/or unsafe act. In fact, a number of studies have found an unsafe act (not always that of the injured person) involved in over 85 per cent of accidents. A safe and healthful place to work will help to eliminate the first cause, and the proper training and supervision of students by teachers will help to eliminate the second cause.

Job safety training of the student begins the day he enrolls in the shop or laboratory. Whether or not the school has a formal induction program, the student starts to learn about his training tasks and form attitudes about many things–including accident prevention–on the first day. The all-important problem of the safety training of students, teachers, and supervisors is covered in Chapter 5.

School administrators can spell out exactly what their policy is with respect to accident prevention, but unless that policy is adhered to and implemented on the teaching-learning level, it will not prevent injuries. Adherence and implementation are the responsibility of the teacher and the teacher's supervisor.

Student Participation and Interest

One of the most effective preventive devices in a school shop and laboratory safety program is student interest and participation in safety activities. Many safety programs fail because the student has not been a part of the program. He has not had the interest and as a result has not been an active part of the "safety team." Chapter 4 offers many recommendations to obtain student participation and interest.

Corrective Action

Corrective action as an exercise of authority is "fault finding" and "fault correcting"–looking for trouble and applying corrective measures or remedies. Success in accident prevention can only be achieved when corrective action is well planned, its steps well organized, and sufficiently trained individuals are present to carry out the plan. Heinrich's[18] HAZARD-THROUGH TRACK as a method of accident prevention is a good example of corrective action. The four phases of this method include: 1) a knowledge of probable or potential hazards, 2) a knowledge of actual or existing hazards, 3) a selection of remedies for the named hazards, and 4) the application of the remedies for the named hazards.

Knowledge of Hazards

The first step to accident prevention through corrective action is the acquisition of knowledge resulting from probable or potential hazards. An individual who is not knowledgeable about hazards would have difficulty recognizing their existence. The hazards referred to are of a direct or proximate nature–unsafe acts of persons or unsafe mechanical conditions. No one person can know all potential or probable hazards, but a successful shop or laboratory teacher **must** at least know them in their general categories; with regard to the teaching activity for which he is responsible, he must know hazards specifically. A study of publications of the National Safety Council, the U.S.A. Standards Institute, U.S. Department of Labor, and other professional texts or manuals will provide the teacher, and the supervisor, with a knowledge of general and specific hazards.

Finding Hazards

A general knowledge of hazards is not enough–they must be found, identified, and analyzed. Discovery of hazards is done through: 1) analysis of past experience, 2) survey and inspection, and 3) judgment and experience plus inquiry. Detailed accident reports and records are the bases of all analyses of past accidents. After finding the potential hazard by survey, inspection, or inquiry, the following steps should be employed: 1) make a cross analysis of the records and select the most important hazards or "targets" to be remedied, 2) determine through the process of elimination the reasons for the existence of hazards, considering such personal obstacles as:

a. Lack of conviction of the seriousness of the hazard.

b. Physical or bodily weakness.

c. Inherent recklessness.

d. Objection to cost.

e. Belief that the education process is affected.

f. Awkwardness or difficulty of the correct procedures.

g. Unawareness of the safe practice or method.

3) determine the reasons for the existence of the hazards which have not yielded readily to correction.

Selecting Remedies

Knowing and finding hazards is only a start. They must be corrected, but a practical remedy must first be selected. Remedies fall into four categories: 1) engineering revision, such as guarding, changing, isolating; 2) persuasion, appeal, instruction; 3) personal adjustment of students; and 4) discipline. Consider the remedies in the order listed above, using discipline only as a last resort. Always consider the selection of the remedy before plunging ahead with the remedy. Much time and effort may be wasted if this isn't done. The selected remedy should include not only the desired corrective action but also the most practical procedure to make that action fully effective.

Applying Remedies

The application of the remedy is the most dynamic part of accident prevention. Unless the remedy is successful, all prior steps are wasted. The teacher in the shop or laboratory may not be able to apply the remedy himself. Therefore, he 1) prepares and effectively presents, recommendations, suggestions, summaries, and plans; 2) gets the support of the supervisory and administrative staff; and 3) creates enthusiasm and cooperation up and down the line of the educational organization. The engineering-revision remedy calls for buying, building, installing, and maintaining guards, new equipment, etc. The persuasion-and-appeal remedy requires teaching, training, education, etc. When obstacles to accomplishment are encountered, the skill of the teacher is taxed the most, and he must have the imagination and ingenuity to overcome these obstacles.

MOTIVES AND INCENTIVES

People have a variety of needs or wants, and quality of performance depends in part on the degree of satisfaction of these needs. Effective exercise of authority is largely determined by the degree of satisfaction the supervised individual directly or indirectly derives from it.

Motives are organic or psychological needs, wants, drives, desires, and impulses within the individual and are forms of internal stimulation. They are such things as hunger, thirst, the drive for security, etc. Incentives, on the other hand, are outside the individual and are a form of external stimulation. They may be tangible objects such as food, money, clean surroundings or intangible rewards such as praise, sympathy, or approval. Particular incentives satisfy or relieve particular needs. We can then say that motivation is the result of something outside the individual (incentives) satisfying something inside (motive). For example, if we apply the incentive of food to the motive of hunger, we obtain the behavior of eating. If we apply the incentive of pay to the motive of economic security, we obtain the behavior of work.

Motives are the mainspring of actions within the individual. They are the chief "why's" of behavior. By knowing the motives of an individual we can better understand his behavior. We can influence a person's behavior by motivating him or applying an incentive to the motive. Some motives are inherited. These inate motives or needs are forms of internal stimulation such as thirst and hunger, and are essentials to survival generally requiring periodic satisfaction. Most of our motives, however, are acquired through learning and experience. These acquired motives are just as real as the inherited motives, and when we are denied satisfaction of them we feel deprived. In the process of seeking satisfaction of innate motives, we acquire or develop other motives. These acquired motives can be classified conveniently as physical, social, and personal. Frequently a conflict of motives occurs. Two or more motives which cannot be satisified at the same time oppose each other within the individual, and the individual is forced to choose which behavior he will express. This leaves the other motives or motives still unsatisfied. There are general types of conflicts: 1) choosing between two attractive things, 2) choosing between two unattractive things, and 3) conflict between attractive and unattractive forces in the same goal. The behavior resulting from a choice usually depends upon the relative strengths of the competing motives. In order to motivate students the teacher must satisfy their needs. The chief motives for which students are seeking satisfaction may be classified as desires for the following:

1. *Personal or emotional security.* These motives are satisfied by a feeling of stability in the shop or laboratory situation which implies consistent and fair treatment and confidence in the teacher. Other satisfactions come from feelings of personal ability to perform the assigned activities, of knowing where one stands, of being approved or liked, and of a sense of belonging.

2. *Recognition or status.* These motives depend for their satisfaction upon good work being noticed and rewarded. They depend upon the individual's estimate of his achievement and the recognition he receives. They also depend upon the sense one has of the importance of his contribution to the school's program or to society.

3. *Self-expression.* These motives are satisfied by a student's feeling that he is using his abilities or that he is developing or growing. They are also satisfied by the student's feeling that he is an active positive participant and that there is sufficient variety in his school work to encourage self-expression and to prevent excessive fatigue and monotony.

4. *Self-respect.* These motives obtain satisfaction from a feeling of individual worth and the sense that one's personal dignity is respected. A sense of having reasonable freedom in the school situation will also serve to satisfy these motives. In addition social standing in one's own group satisfies this need. The desire for self-respect is a vital personal need which influences much of our behavior.

Incentives may be considered as positive or negative depending on whether we are attracted or repelled by them. For the purpose of illustration, suppose we have a donkey that we want to go to some particular place. One way to motivate the donkey would be to stand behind him with a stick and give him a good whack, which might result in a kick from the donkey, the donkey's moving in just about any direction, or the donkey's going where we want him to go. On the other hand, we understand that donkeys like carrots. If we stand in front of him and hold out a carrot, his reaction would probably be to go where we want him to go. Incentives, therefore, can be positive (the carrot) or negative (the stick). Positive incentives are rewards that satisfy needs. Negative incentives are punishments that stimulate behavior to avoid the pain. Positive incentives are harder to use and must be suited to the needs of the individual. Negative incentives can be easy to use and quick in effect—most people respond to them. However, using negative incentives is apt to result in a response we do not want.

Techniques of Motivation

We have said that motivation is the result of something outside the individual (incentive) satisfying something within the individual (motive). The identification of incentives is therefore very important to the shop or laboratory teacher who desires the kind of behavior from his students which best contributes to an accident prevention program. The following are only a very few of the on-the-job incentives that can be applied by the teacher.[19]

1. **Good physical working conditions are fundamental for satisfying some of the student's motives.** In addition, provisions for comfort, health, and safety are a primary means of giving students a feeling that their needs and wants are being considered.

2. **Friendly working relations satisfy the social desires for companionship and a sense of belonging and thus encourage teamwork and a liking for the school situation.** Each student usually desires to belong to the group to which he is assigned and also to the informal social groups which arise. A student may well develop a sense of belonging in an informal group by exhibiting the same attitude toward accident prevention as held by that group. The teacher must evaluate the best techniques of using informal group activities to help the safety program or at least to recognize them as a source of motivation. A new student may be "sold" on safety by his teacher, but he can be rapidly "unsold" if he finds that his group holds a contrary attitude. The teacher will do well to heed this desire to belong and make sure no student is left out of the safety program.

3. **A sense of participation in a group activity is another primary incentive.** Knowledge of what is to be done and why it is to be done increases the significance of learning activity for the student and, therefore, the satisfaction of the students in doing it. When it is feasible to allow students to share the problems and responsibilities of the class, there generally results an increase of individual feeling of responsibility and importance in meeting group goals. The experience of teamwork in group activity gives a maximum sense of participation to every student and a genuine feeling of accomplishment when the group goals are achieved. School safety programs have a better chance of success if every student feels that he is an actual part of the program. Through such activities as serving on safety committees, all students may feel that they are an integral part of the program and have a responsibility to insure the success of the program. Thus, they are committed to safe practices.

4. **Recognition of the efforts of each student is another fundamental basis for satisfaction.** A teacher, by showing frequent interest in the work or every student, will help to create a feeling in each student that his work is significant and that he is being treated as in individual. Both criticism and praise are a means of recognizing individual effort. Criticism directed toward the job rather than the person can be a highly effective incentive be-

cause it recognizes the individual without degrading his ego. Praise appropriate to the individual and suitable to the occasion is usually effective in improving performance, since it is a positive and powerful appeal to the motive of self-respect. The safety specialist, having laid plans and developed the means of administering them, has a real sense of achievement when there is a decrease of accidents and the value of work is recognized by his superiors. If the safety specialist gives credit to the teachers for their part in the reduction of accidents, and the teachers in turn pass the credit on to the students, recognition will be given where it will count most toward making accident prevention effective. On the other hand, if a student has contributed toward the success of a safety program without receiving any recognition, he may develop a negative attitude toward the whole program because his need for recognition is not satisfied.

5. **Competition is an incentive which may be effective in stimulating desired safety practices.** Competition on an individual basis is most effective because the individuals are directly responsible. Competition among equals may create a highly motivating situation in which work is more enjoyable. Group competition may provide better teamwork and group spirit. In a cooperative work group, friendly competition often develops between individuals or sub-groups with a resultant increase in learning and in student morale. However, competition can be an unsatisfactory incentive if it degrades individual or group self-respect, as in the case of competition between unequals.

Formal competitions usually are held only after the basic steps in an accident prevention program have been taken—a records systems adopted, equipment safeguarded, a first aid policy established. Such substantial demonstration of administrative interest, sincerity, and responsibility greatly helps to obtain the active participation of teachers and students in a contest. Safety contests are operated purely for their interest-creating value (*e.g.*, they will not of themselves prevent accidents). A contest that creates favorable interest is valuable; one that does not create interest is worthless. Generally, contests are based on accident experience and operate over a stated period with a prize for the best record almost from the time of the first safety program, and a fairly well-established group of operating principles has been developed. These principles should apply equally well to a school shop and laboratory safety contest:

a. A contest should be plannned and conducted by a committee representative of the competing classes or groups.

b. Competing groups should be natural units, not arbitrary divisions.

c. Methods of grading must be simple and easily understood.

d. The grading system must be fair to all groups.

e. Awards must be worth winning in order to create interest.

f. Good publicity and enthusiasm are important.

6. **The senses of acquiring skill or new knowledge and of growth in the training situation are powerful stimuli to better safety performance.** All people are motivated to some degree to grow

and develop. An opportunity to develop new skills and knowledge in different assignments gives a satisfying sense of progress, even though no promotion may be involved. Training students in proper work techniques and practices will include training in safety.

7. **A knowledge of his own results improves the individual's performance by satisfying his urge for achievement.** One piece of work completed provides an urge for more accomplishment. A sense of achievement helps the individual to recognize the difference between undirected activity and effective action. In a work group, a knowledge of group results also provides a sense of achievement for the individual student. Achievement is essential to a feeling of personal worth, and every student who turns out a good piece of work has this feeling. Students can have this same sense of achievement if the school makes them feel that they are integral parts of the safety program cooperating in the reduction of accidents.

8. **Proper assignment to a learning activity is a motivating factor from which students can obtain a sense of personal security and a greater feeling of accomplishment.** Where the interests, aptitudes, and personality of the student closely match the requirements of the activity, there is a much greater chance for better performance. If a student lacks security, he will react emotionally to people and events around him, and his recollection of proper work methods or necessary safety precautions may be impaired. On the other hand, he may know that taking a shortcut exposes him to later accident risk, yet he may do so in order to gain approval from his peers or to gain additional attention from his supervisor. Stress in the work situation is a cause for high accident rates. In fact, some researchers have attributed a major portion of accidents to unhealthy psychological climates.

9. **Satisfactory orientation to a new shop situation may serve as an incentive, appealing to the desires for security and belonging on the part of the new student.** The student needs and wants to know what is expected of him in terms of duties, responsibilities, behavior under regulations, and other factors which may affect him as an individual student. The student wants to know why certain things are necessary, and explanations of the purposes of personal protective equipment or safe work methods will make the student more willing to comply. It should not be beneath the dignity of the teacher to explain to the student the specific work method and its relationship to the hazards involved.

10. **Encouragement and consideration of student suggestions tend to improve performance by providing the student with a sense of recognition.** The safety suggestion system is accepted by industry as an efficient device in accident prevention programs. Such a system should be employed in school shops and laboratories, not only to help prevent accidents but also to improve the health and morale of the students.

DOCUMENTATION

Documentation in organization means the reduction to written or chart form of all information about structure, assignment of functions, policies, and relationships that members of the organization (and those in frequent contact with the organization) need to know in order to do their work efficiently. Documentation in accident prevention–a process of furnishing proof or evidence–includes the following elements:

1. **Organization charts.** There are several types of charts that may be used to portray graphically the plan of organization for accident prevention in school shops and laboratories. The most common are:

    a. *Structural* charts, used primarily to show the relationships among the various elements of the organization–state units, such as the board of education, superintendent of schools, subject matter specialists, safety specialists, etc.; and local units, such as county, district or city boards of education, superintendents of schools, subject matter directors, and supervisors, safety specialists, teachers, and students. These charts show the framework or anatomy of an organization without including an excessive amount of distracting information.

    b. *Functional* charts, used primarily to fix responsibility or duties by assigning them to specific segments of the organization. Within the various "blocks" of the chart a statement or listing of the functions assigned to individual organizational sections is presented.

    c. *Position* charts, used primarily to show the names, positions, and titles of individuals as they fit into the plan of organization.

    d. *Flow* charts, used to show the steps followed by the organization in the processing of its responsibilities.

    e. *Combination* charts are two or more of the above charts combined together. Structural, functional, and position charts may be combined by including in each "block" all of the data that would be carried separately on the three types of charts. Combination charts are practical when the organization is simple, but in a complex organization with many levels and subdivisions such a combination chart may be of unmanageable size.

2. **Statement of functions.** This is a clear-cut itemized list of activities, duties, or functions for each element of the organization. When shown graphically, it is called a functional chart (see 1b above). The statement of functions should show in a detailed outline form the functions of each subdivision and each individual in the safety organization.

3. **Statement of policy.** Such statements are usually administrative in character. They are usually in written form to assure preservation and to facilitate distribution to all concerned members of the organization. Statements of policy may appear in the form of minutes for meetings or conferences, short notes, memoranda, letters, or handwritten notes. However completely and accurately the file of policies is maintained, its value is as a reference or recording system rather than as the actual basis for operation.

4. **Plans and programs.** This Guide includes formats of three types: Plans of action for accident programs, a state plan, a local plan, and a shop or laboratory plan. Such plans outline the course of action to be followed in progressing toward the safety objectives of the organization and should be prepared at the outset for all levels of the program.

5. **Statistics** include simplified and readily comprehensible data showing facts about performance and trends. The most common statistical tools include:

   a. Tabular presentation of data.

   b. Graphic presentation of data.

   c. Measures of central tendency.

   d. Measures of variability.

   e. Correlation.

   f. Sampling.

   g. Measures of reliability.

   In accident prevention, statistics are used to cover such items as:

   a. Frequency of injuries.

   b. Severity of injuries.

   c. Body parts impaired.

   d. Accident costs.

   e. Types of injuries.

   f. Sources of injuries.

   g. Operations involved in accidents.

   h. Trend and degree of change in accident rates.

   i. Student-hours of exposure to shop or laboratory activities.

6. **Reports.** The size and complexity of the accident prevention program will determine the nature and frequency of necessary reports. Types of reports necessary to record the operation of a safety program would include:

   a. Reports of accidents.

   b. Accident investigation reports.

   c. Inspection reports.

d. Performance reports.

e. Accident cost reports.

f. Safety committee reports.

g. Equipment maintenance reports.

h. Safety-suggestion reports.

i. Hazards reports.

7. **Forms.** An accident prevention program requires several important forms for effective and efficient administration of the total system. Most of these are included in the following listing:

a. *Accident report.* A detailed presentation of forms used to report accidents is included in Chapter 4.

b. *Inspection check list.* The American Vocational Association and the National Safety Council have cooperated to produce inspection check lists useful in the development of safety environments in school shops and laboratories. These are described in Chapter 4.

c. *Student safety foreman's report.* This is a form devised for the local program as a check list to be used by the student safety foreman while making his daily "rounds" of the shop or laboratory as part of his safety duties. The form provides checking columns for each day of the week and is designed specifically for the subject matter area being taught. The form is initialed daily by the teacher. The duties are usually listed in three subdivisions: 1) beginning of class, 2) during class, and 3) end of class. The assignment of a student safety foreman in no way relieves the teacher of his accident prevention responsibilities.

d. *Safety suggestions.* These are simple forms available near the safety suggestion box for use by students for submitting safety suggestions to the shop safety committee. The form, in addition to providing space for the specific suggestion(s), includes space for the student's name and the shop or laboratory in which he is working.

e. *Parent-permission slips.* This form is usually a 3 in. x 5 in. card on which the parent signs to indicate permission for students to operate hazardous equipment. This form notifies the parent about the nature of the work being done by the student and also informs the instructor about any reservations the parent may have concerning the student's participation in the work activities of the shop course. It does not, however, relieve the teacher of his responsibility for the safety of the members of his class, nor is it effective as protection for the teacher against possible action which might be instituted by parents as the result of student injury occurring in the shop area.

f. *Operator's card.* This is a very small card or folder which can be carried in a billfold by the student to indicate that he has successfully completed the requirements and acquired the skills, knowledge, and habits necessary to operate power-driven machines safely. Students who become careless may have their licenses revoked. A card of this type represents an accomplishment and a privilege and has a desirable psychological effect on the student.

g. *Fire extinguisher inspection.* This is a checklist maintained by the instructor or authorized student representative to provide evidence that fire extinguishers have been inspected at regular intervals (at least once each week). This is in *addition* to the official inspection made by certified fire safety specialists.

h. *Hazard report.* This form is completed by the teacher and submitted to the principal or director regarding any hazardous physical condition in the shop (this form is not to be confused with the inspection checklist). Colored forms should be provided to emphasize the degree of urgency for correction of the hazard: *Red* for "urgent," *blue* for "important," and *green* for "desirable."

i. *Visitor's permit.* This is a small card on which approval is given by the principal, or his authorized representative, for visitors to enter a shop or laboratory. This is a necessary administrative "nuisance" which protects students, teachers, and visitors as well. Visitors can easily injure themselves or cause injury to others as they move through a shop if unescorted by the teacher. They can become distractions to the students as they perform their hazardous tasks. There may also be possible liability action against the teacher if a visitor is injured while in the shop.

j. *Safety pledge.* This is an 8½ x 11 in. form which the student completes to acknowledge his having received safety instruction and as a "promise to observe the safety instruction." The form is signed by the student and the teacher and remains in the teacher's files as long as the student is enrolled in his classes. A suggested safety-pledge form is found in Appendix D.

REFERENCES

1. Earl P. Strong, *The Management of Business,* (New York: Harper and Row, 1965) pp. 39-42.

2. Ibid, p. 132.

3. Ibid, pp. 109-110.

4. Ibid, p. 115.

5. Harold Koontz and Cyril O'Donnell, *Principles of Management,* (Third ed., New York: McGraw-Hill Book company, 1964) p. 518.

6. National Safety Council, *Accident Prevention Manual for Industrial Operations,* (Fifth ed., Chicago: National Safety Council, 1964) pp. 5-2 and 5-3.

7. Seymour L. Wolfbein, "Implications of Changing Technology for the Training of People," *Proceedings of The President's Conference on Occupational Safety,* Bulletin 263, U.S. Department of Labor, Bureau of Labor Standards, 1964, p. 201.

8. U.S. Department of Health, Education and Welfare, Office of Education, *School Shop and Laboratory Safety,* Report of a National Conference, 1964, p. 29.

9. Ibid, pp. 31-32.

10. U.S. Department of Health, Education and Welfare, *op. cit.,* p. 30-31.

11. Koontz and O'Donnell, *op. cit.,* p. 530.

12. Koontz and O'Donnell, *op. cit.,* p. 43.

13. Koontz and O'Donnell, *op. cit.,* p. 67.

14. William A. Williams, ed., *Accident Prevention Manual for Shop Teachers,* (Chicago: American Technical Society, 1963) p. 364.

15. National Safety Council, *op. cit.,* p. 2-11.

16. Williams, *op. cit.,* p. 220.

17. U.S. Department of Labor, Bureau of Labor Standards, *Control of Physical Environment,* Bulletin 211, p. 2.

18. H. W. Heinrich, *Industrial Accident Prevention,* (New York: McGraw-Hill Book Company, 1959) pp. 69-73.

19. American Telephone and Telegraph Company, "Motivation and the Job," *Human Relations in Management,* 1949, pp. 7-9.

CHAPTER 4

IMPLEMENTING THE ACCIDENT PREVENTION PROGRAM

School shops and laboratories can play an important role in developing sound occupational concepts and attitudes. Programs of accident prevention in such educational areas must include formal and informal techniques and practices for building safety attitudes and habits. Each teaching-learning situation in the school shop or laboratory has the potential for promoting safety consciousness; therefore, effective and continuing efforts must be made by educational administrators, supervisors and teachers to provide a safe environment and effective instructional practices to guide our youth and adults safely through their school-related learning experiences. It is then the hope of educators that these acquired safety habits and concepts will remain with the students after they leave school.

This chapter deals with the implementation of the accident prevention program outlined in the preceding sections of the guide. It presents certain practices and procedures to school administrators which should insure an effective and efficient program of safety in school shops and laboratories. Included are the following materials:

1. Preferred safety practices for shop teachers.
2. Safety standards.
3. Hazard analysis.
4. Safe use of instructional equipment and materials.
5. Facility design and layout.
6. Manual handling and storage of materials and tools.
7. Machine guarding.
8. Maintenance for safety.
9. Fire prevention and extinguishment.
10. Electrical hazards.
11. Housekeeping.
12. Health hazards.
13. Personal protective equipment.

14. Emergency action plans.

15. Inspections.

16. Accident reporting and analysis.

PREFERRED SAFETY PRACTICES FOR SHOP TEACHERS

The following list of safety practices was abstracted from a doctoral study conducted to determine preferred practices in safety education in Pennsylvania vocational industrial school shops.[1] A check list of 181 safety practices was derived from a study of relevant literature and from conferences with vocational industrial education administrators and teachers in Pennsylvania and from a panel of experts from twelve states. Specifically, the nature and desirability of the safety practices employed in shops were evaluated by teachers and local vocational administrators. These evaluations were of major significance to the findings. The teachers, administrators, and jury were asked to evaluate each practice as most desirable, desirable, or undesirable. Resultant tabulations and calculations produced the following list of preferred practices. One hundred and twenty of the original 181 practices are presented under ten specific headings:

1. Safety inspections.

2. Accident reports.

3. Instructional techniques.

4. Equipment safety.

5. Housekeeping practices.

6. Electrical safety.

7. Fire safety.

8. First-aid practices.

9. Personal protection.

10. General practices.

Although the following listing applies to the preferred safety practices of school shop teachers, many of the practices will apply equally well to school laboratories.

Safety Inspections

1. Use a safety check list to assure that all safety factors are checked during safety inspections.

2. Use the American Vocational Association-National Safety Council's "National Standard School Shop Safety Inspection Check List" during shop safety inspections.

3. Have frequent safety inspections of the shop made by:

   a. School personnel–state and/or local level.

   b. A student safety committee.

   c. A student inspector or foreman.

   d. Industrial safety engineers.

   e. Inspectors from the state departments of labor and industry.

   f. State fire inspectors.

4. Rotate assignments of students to the shop safety committee.

5. Rotate assignments of students as safety inspectors or safety foremen.

Accident Reports

1. Require students to report all accidents to the teacher, regardless of nature or severity.

2. Keep a record of all shop accidents resulting in injury to students, regardless of nature or severity.

3. Analyze all accident reports for the purpose of aiding in the prevention of other accidents.

4. Use a printed or duplicated form to record the details of shop accidents.

5. Make a report to the school administration on all shop accidents resulting in injury to students, regardless of nature or severity.

6. Prepare a monthly summary of all accidents in the shop for the director or principal for inclusion in a composite summary of all accidents in the school.

Instructional Techniques

1. Develop a permanent safety consciousness in students through teacher example–always doing things the safe way.

2. Teach accident prevention with a positive approach–stressing the right way to perform an operation.

3. Give shop demonstrations emphasizing the safe use of hazardous machines.

4. Give shop demonstrations emphasizing the safe use of specific hand tools.

5. Present safety instruction with the following objectives in mind:

    a. Developing in each student a sense of responsibility for his own safety and that of others.

    b. Helping students understand that the safe way of doing things is effective.

    c. Helping students recognize situations involving hazards.

    d. Helping students learn safe practices to use in their own day-to-day activities.

6. Provide instruction on what to do in case of a shop accident.

7. Use information sheets dealing with the safe use of specific hand tools.

8. Use information sheets dealing with the safe operation of hazardous machines.

9. Give periodic shop demonstrations on the proper use and care of personal protective devices.

10. Use information sheets dealing with the general safety rules of the shop.

11. Provide for safety instruction in the course of study.

12. Provide instruction in the maintenance of shop tools, machines, and other equipment.

13. Provide instruction in the safe methods of lifting and/or moving heavy equipment or other loads.

14. Provide a bulletin board for safety bulletins, safety posters, safety rules, and regulations.

15. Give periodic shop talks to emphasize the importance of each student acquiring the proper attitude towards accident prevention.

16. Conduct field trips to industrial plants or construction jobs to study safety practices.

17. Send letters to parents when a student has exhibited a great degree of interest in safety or when he has successfully applied safety practices to handle a shop situation.

18. Require all beginning shop students to make a careful study of hazards in the shop during the first few days of the course.

19. Provide a safety suggestion box for student use.

20. Provide for visiting speakers from business and industry to speak on occupational safety and health practices.

21. Prepare a written safety education program for the shop–similar to a course of study.

22. Require each student to sign information sheets dealing with shop safety rules and regulations to indicate that he has read and understood the information. These sheets should be kept on file until the student completes his course of instruction.

23. Prepare a written safety education program for the shop and submit to the school administration for their information.

Equipment Care and Operation

1. Enclose all gears, moving belts, and other power transmission devices with permanent guards or barricades.

2. Permit each student to operate a hazardous machine only after demonstrating his ability to operate the machine safely.

3. Require a signed statement from a parent granting permission for students to operate power machines.

4. Permit students to operate a hazardous machine only after passing an examination on the safe operation of the machine.

5. Provide an operator's card or license to each student who successfully completes the necessary qualifications to operate power-driven machines.

6. Require that all hand tools are kept sharp, clean, and in safe working order.

7. Prohibit students from operating hazardous machines when the instructor is not present.

8. Prohibit the use of any defective tools, machines, or other equipment.

9. Maintain strict supervision of students who are using hazardous machines and dangerous tools.

10. Prohibit the removal of guards and safety devices, even for a brief interval, without the approval of the teachers.

11. Prohibit students not enrolled in shop classes from operating any of the machines in the shop.

12. Prohibit more than one operator from using the hazardous machine at one time.

13. Provide and require the use of point-of-operation guards for operations involving machine cutting, drilling, shaping, planing, boring, and forming.

14. Maintain an awareness of the effective use of safeguards against the special hazards associated with the shop instruction.

15. Use painted lines on the floor around each hazardous item of equipment.

16. Place a warning sign on equipment that is unsafe to operate.

17. Prohibit conversations between machine operators and other students while using hazardous machines.

18. Fasten all machines securely to the floor.

19. Post safety rules at or near each hazardous machine or danger area.

20. Use standardized color coding on hazardous machines to emphasize danger areas.

21. Fasten all benches securely to the floor.

22. Accept personal responsibility for all students using machines or hand tools in the shop.

23. Disconnect the main power line when the teacher leaves the shop for any period of time.

Housekeeping Practices

1. Provide for the daily removal of all sawdust, shavings, metal cuttings, and other waste material.

2. Provide a toeboard and railing around all balconies used for overhead storage of supplies, equipment or shop projects.

3. Provide properly marked boxes or bins for various kinds of scrap stock.

4. Employ a standard procedure to keep floors free of oil, water, and foreign material.

5. Provide brushes for the cleaning of equipment after each use.

6. Provide for the sweeping of the shop floors at least once each day depending on the rate of scrap accumulation.

Electrical Safety

1. Make all equipment control switches easily accessible to the operator.

2. Provide a ground on all motors, fuse boxes, switch boxes, and other electrical equipment.

3. Teach students to assume that all electrical apparatus is "hot" and must be treated as such.

4. Provide overload protection on all motors.

5. Provide sub-master switches for disconnecting power-driven machines at convenient locations throughout the shop.

6. Provide fluorescent lights for the general lighting of the shop.

7. Provide individual cut-off switches for each machine–separate from operator control switch.

8. Prohibit use of temporary wiring of any kind in the shop area.

9. Provide individual lights at each machine.

Fire Safety

1. Provide fire extinguishers in the shop area.

2. Store flammable liquids in approved safety containers.

3. Provide for the inspection and testing of fire extinguishers at regular intervals to ascertain if they are fully charged and in proper working condition.

4. Provide instruction in the location and proper use of fire extinguishers and other fire-fighting equipment.

5. Provide instruction in the prevention of fires in the school shop.

6. Provide periodic instruction and practice in the proper procedure for evacuating the shop in case of fire or other emergency situations.

7. Provide for the bulk storage of flammable materials in an area removed from the main school building.

8. Mark the location of fire-fighting equipment in the shop with a large bright red square, arrow, or bar high enough to be visible from any part of the shop.

9. Inspect paint and chemical cabinets periodically, noting the date of inspection on or in the cabinet inspected.

10. Provide in an easily accessible location in the shop a large flame-proof blanket for use in the case that someone's clothes ignite.

11. Post instructions for evacuating the school shop in a conspicuous place where they can be seen and read.

12. Prohibit use of flammable liquids for cleaning purposes.

13. Inspect fire extinguishers and other fire fighting equipment at least once each week.

First Aid Practices

1. Provide a first aid kit in the shop.

2. Mark the location of the kit with a green cross large enough to be visible from any point in the shop area.

3. Inspect first aid cabinet periodically to determine condition and amount of supplies.

4. Post the policy of the school regarding the administration of first aid in a conspicuous place in the shop.

5. Enroll in and successfully complete American Red Cross first aid courses.

6. Provide only emergency first aid treatment for serious injuries and then refer to qualified medical personnel for treatment.

Personal Protection

1. Prohibit running in the shop at any time.

2. Prohibit horseplay or practical jokes of any kind within the shop area.

3. Require the wearing of appropriate eye protection (safety goggles or glasses) during any type of grinding operating.

4. Require students to observe prescribed rules in regard to proper clothing and protective devices when operating hazardous equipment.

5. Require the wearing of eye protection with appropriate lens when danger from radiation or glare exists.

6. Stress the importance of shop sanitation.

7. Require the wearing of proper eye protection when there is a danger of flying particles or chips.

8. Provide proper respirators for student use where harmful dusts or fumes exist.

9. Require the supplemental use of face shields during the hazardous operations in cutting metal, wood, or other similar materials.

10. Determine the physical defects and limitations of all students so that they will not be assigned tasks detrimental to their health or physical condition.

11. Provide "school purchased" personal protective equipment for student use.

12. Prohibit the wearing of long neckties in the shop.

13. Prohibit the students from wearing rings and other jewelry while working in the shop.

14. When such protective devices are furnished by the school, require sterilization of safety goggles or glasses before reissue.

15. Emphasize the importance of wearing coveralls as proper shop clothing.

General Practices

1. Make an analysis of all hazards in the shop involving machines, hand tools, and general environment.

2. Make regular written reports to the principal or director regarding any hazardous conditions in the shop.

3. Provide a non-skid floor surface in the operating area of all hazardous machines.

4. Use alternating yellow and black stripes on protruding parts, low beams, and tripping hazards.

5. Have the ventilation system in the shop checked at the beginning of each school year by a trained and experienced ventilation engineer to determine effectiveness.

6. Provide aisles at least four-feet wide throughout the shop for general travel.

7. Use a bell, whistle, or some other type of alarm to command the attention of every student in the shop during emergency situations.

8. Require students to sign an acknowledgment of safety instruction and safety pledge.

9. Carry liability insurance as a protection against possible negligence charges brought by parents of injured students.

10. Encourage all students to carry accident insurance while enrolled in shop courses.

11. Require visitors to get approval from the director or principal before entering the shop.

SAFETY STANDARDS

Codes, standards, and rules must be considered by teachers as important factors in the development of an accident prevention program. As the future workers of business and industry, shop and laboratory students should be thoroughly aware of safety standards. They should be acquainted with the codes and regulations pertaining to machine guarding, industrial housekeeping, fire protection, dust removal, handling materials, personal protection, etc. Standards of safety have a direct bearing on the development of safe work habits and attitudes, and when individuals do not act in accordance with safety standards, accidetns are liable to occur. Russell DeReamer[2] emphasized this point when he said: "Workers use the five primary senses, sight, smell, taste, touch, and hearing to perceive objects, signals, and changes in the work environment. Each perception is relayed through the nervous system to the brain, where the information is noted and evaluated. In making the evaluation, the worker is guided by past training and experience. When the perception is consistent with the worker's previous experience, a correct evaluation is made in a second. On the other hand, a new situation and in particular one which is inconsitent with previous established patterns may confuse the worker or at least slow up his reaction time." The consistent use of safety standards permits workers *and* students to rely on their past experiences and habits to contend with work hazards with a higher degree of safety.

Safety standards may be used by teachers to draw comparisons and make evaluations. The use of standards as a basis for evaluating shop elements, processes, and work practices is essential for the development of an effective accident prevention program. Such standards may be classified in two general categories: 1) regulatory standards, and 2) self-applied standards.

Regulatory Standards

Regulatory safety standards are legislative enactments adopted by governments to correct specific hazardous conditions and practices. Such laws or rules contain certain requirements considered necessary to prevent accidents. Many states have developed such safety standards or codes. In some cases, notably Pennsylvania, these code systems are extensive.

Legislation which attempted to deal with individual hazardous working conditions and practices in detail proved to be unsatisfactory, according to Blake,[3] because of the following difficulties:

1. Legislative enactments are difficult to modify and details cannot be kept up-to-date with the changing needs of our developing industry.

2. Occupational hazards are so numerous and varied that detailed legislation cannot cover them adequately without becoming impossibly complex.

3. Such detailed legislation cannot be enforced without causing so many hardships that it will largely defeat its purpose.

4. Securing reasonable uniformity in such detailed enactments by the various state legislatures and the Federal Congress is a practical impossibility.

Blake[4] suggests the following procedure for drafting safety codes:

1. All groups having a legitimate interest in the proposed standard are invited to take part in its drafting.

2. The inspection service agency which administers the standards usually prepares tentative drafts and submits copies to a committee representing all interested groups.

3. These tentative standards, with changes or additions as approved by this committee, then go to the approval authority for its consideration and action as required under the law.

Very few states have enacted safety legislation dealing specifically with school shops and laboratories. Notable exceptions, however, are the states which have very recently enacted eye-protection legislation. A study made by Wayne P. Hughes of the National Safety Council and reported in the *School Shop Magazine*[5] indicates that by late 1965, 22 states required by state law, or its equivalent, 100 per cent eye protection in school shops and laboratories. Similar laws are under consideration for other states. The following is a "true and correct copy" of such an act which was signed into law in Pennsylvania on July 19, 1965, by Governor Scranton:

Section 1. Every teacher, student, visitor, spectator, and every other person in any shop or laboratory in public or private schools, colleges and universities who is engaged in or is within the area of known danger created by a) the use of hot liquids, solids, or gases or caustic or explosive materials, or b) the milling, sawing, turning, shaping, cutting, grinding or stamping of solid materials, or c) the tempering, heat treatment or kiln firing of metals and other materials, or d) gas or electric welding, or e) the repairing or servicing of vehicles shall wear industrial quality eye protective devices at all times while engaged in such activities or exposed to such known dangers.

Section 2. Schools, colleges, and universities shall have the power to receive federal, state, and local monies and to expend the same to provide such devices and shall furnish such devices to all visitors and spectators and all other persons required under the provisions of this act to wear them.

Section 3. Enforcement of this act shall be in accordance with standards, rules, and regulations promulgated by the state board of education.

Section 4. For the purpose of this act "industrial quality eye protective devices" mean devices meeting the standards of the USASI Code for head, eye, and respiratory protection, Z2.1-1959, promulgated by the United States of America Standards Institute.

Section 5. This act shall take effect immediately.

The following example of a "local mandate" is extracted from the *Administrative Guide* of the Los Angeles City School Districts under the title of "Safety Tests":[6]

1. Each secondary school pupil enrolled in agriculture, art, homemaking, industrial arts and vocational courses shall be given the appropriate written safety test at least once each school year.

2. A record of the date upon which each pupil passed the safety test shall be kept in the class roll book and the safety test shall be placed on file.

3. In case of a recordable accident to a pupil, the pupil's written safety test shall be withdrawn from the file at the time the pupil's accident report is prepared and shall be placed in the school vault or forwarded to the insurance section of the business division where it shall be kept until the pupil attains the age of twenty-four years and three months.

Use of USA Safety Standards as Codes

Because of the difficulty of securing legislation to delegate the authority to draft rules which have the force and effect of law (safety codes), many states have turned to the use of USA Safety Standards (formerly American Safety Standards) as advisory standards. These are reprinted with a suitable foreword and issued with the recommendation that all employers apply them when they are suitable to their respective establishments. They reinforce their recommendation by authorizing factory inspectors to use these standards as guides for issuing corrective orders. The effectiveness of this method raises the question of whether or not formal regulatory standards are actually worth the extra trouble involved in formulating and periodically revising them. For constitutional reasons this procedure is complicated, time consuming, and relatively expensive. It involves public hearings, legal records of the procedures, the publication of the drafts to be passed upon, and other details to protect the rights of those who might be affected by the regulations. In contrast, the drafting of advisory codes is a simple matter. USA Safety Standards covering most of the machinery and equipment usually dealt with by regulatory codes are available and need only to be reproduced in suitable form. Moreover, sound informational material is also available with which gaps in the standards may be filled."[7]

Self-Applied Standards

Self-applied safety standards are those which have been developed as being representative of current good practices by various groups and individuals interested in accident prevention. Such standards are derived from experience and are accepted and employed on the basis of their practical value as aids in the prevention of accidents and the reduction of personal injuries. Several organizations at the national level have done much in creating voluntary, self-applied safety standards and regulations. These organizations include the National Safety Council, United States of America Standards Institute, Underwriters' Laboratories, National Fire Protection Association, and the American Society for the Testing of Materials. The United States of America Standards Institute (USASI), for example, has approved over 1800 standards of various kinds for use by trade associations, societies, organizations, and professional groups. The work on safety codes is under the advisory direction of the USASI safety standards board. Its functions include:

1. Investigating the need for particular standards.

2. Defining and limiting the scope of standards.

3. Considering the interrelation of standards.

4. Passing upon the personnel of technical committees.

5. Following up the work on standards.

6. Acting as a general clearing house on safety standards.

USASI headquarters, located at 10 East Fortieth Street, New York City, 10016, will furnish current lists of American standards upon request. Every school administrator and school safety specialist should have copies of all that are pertinent to his work. The bibliography includes many of these code titles which would be widely useful to educators conducting school shop and laboratory accident prevention programs.

Local Shop Rules and Regulations

The practice of using safety rules varies from one school system to another. However, most school shops have definite rules and regulations to follow and the teacher has the responsibility for their enforcement. Such rules may apply to: 1) a specific subject area, or 2) a specific machine or piece of equipment, or 3) to several subject areas. The following rules, taken from the *Safety Manual for Industrial Education* published by the Los Angeles City Schools,[8] apply to the subject area of printing:

1. Keep flammable cleaning solvents away from intense heat or potential sparks.
2. Never use any solvent with a flash point of less than 100 F.
3. Keep all solvents in labeled safety cans.
4. Identify chemicals by the label or by asking the teacher. Do not smell any chemicals.
5. Make certain that the room is ventilated before using any volatile chemicals.
6. Wash hands immediately after using any chemicals.
7. Do not tilt chairs.
8. Do not lean on glass tracing or make-up tables.
9. Dry hands before touching any electrical switches, plugs, or equipment.
10. Do not make any electrical repairs to shop appliances or equipment; notify the teacher promptly regarding any defective equipment.
11. Learn the location of the main switch for each machine so that it can be turned off quickly in case of an emergency.
12. Do not permit oil or debris to accumulate on the floor around any machine.
13. Exercise care while opening the tight covers of ink cans or other containers.
14. Keep aisles and passageways clear of material and equipment.
15. If the press will not function, or if repairs are being made, place an OUT OF ORDER sign on it and pull the fuses.

16. Keep fingers clear of the grippers on all presses.

17. Do not use the hand as a brake to stop the fly wheel.

The following safety rules, also taken from the Los Angeles manual, apply specifically to arc welding:

1. Perform arc welding only in a screened or enclosed force-ventilated area.

2. Be sure that screens, curtains, or other protective devices have been set up or drawn tight so that the arc flash can be seen only by students wearing a protective shield.

3. Wear an arc welding helmet with proper lens, treated gauntlet gloves, and treated leather apron as protection against ultra-violet and infra-red rays, flames, and hot metal.

4. Make certain that the shield has no openings.

5. Do not permit anyone in the welding booth unless he is wearing an arc welding helmet.

6. Wear a protective leather welding jacket and apron or heavy old clothing.

7. Keep sleeves and pants cuffs rolled down and collar buttoned up.

8. Be sure that the tops of shoes are covered.

9. Protect face and eyes with safety goggles or a flip-front helmet when chipping slag from welds.

10. Report to the teacher at once if the electrode holder, holder cable connections, cable or cable terminals at the welding machine, ground clamp, plugs, or cable become hot.

11. Secure electrical contacts and grounds to prevent fire or burns.

12. Shut off the welder when welding is completed as a protection against sustained short circuits.

13. When work is completed, suspend the electrode in a manner that will prevent it from touching any metal which could cause it to ground.

14. Keep cable from contacting hot metal.

15. Keep electrode stubs off the floor. They could easily cause a slip or fall.

16. Avoid inhaling of fumes while welding galvanized steel, phosphor bronze, and stainless steel.

HAZARD ANALYSIS

The National Safety Council enumerates the basic measures for preventing accident injury, in the order of effectiveness and preference, as follows:[9]

1. Eliminate the hazard from the machine, method, material, or plant structure.

2. Control the hazard by enclosing or guarding it at its source.

3. Train personnel to be aware of the hazard and to follow safe job procedures to avoid it.

4. Prescribe personal protective equipment to shield personnel against the hazard.

Reference is made in each of these measures to the "hazard." Hazard analysis or identifying the hazard is therefore necessary before any of the four measures can be employed to reduce exposure to accidental injury.

Hazard analysis, referred to in industry as "job safety analysis" or JSA, is a procedure to make a job safe by 1) identifying the hazards or potential accidents associated with each step of the job, and 2) developing a solution for each hazard that will either eliminate or control the exposure.[10] The school shop or laboratory teacher can profitably make an analysis of each job project, exercise, or experiment into its component operations and steps to reveal 1) the existence of physical hazards such as tools, machines, materials, etc., 2) hazardous positions, or actions of students, 3) the necessary qualifications for the performance of the "job," such as physical fitness, special abilities, etc., 4) the safety equipment and devices needed for accident prevention, and 5) the safety standards, including rules and regulations, required for the protection of the students.

The four basic steps for making a job safety analysis (JSA) as recommended by The National Safety Council[11] are:

1. Select the job to be analyzed.

2. Break the job down into successive steps.

3. Identify the hazards and potential accidents.

4. Develop ways to eliminate the hazards to prevent the potential accidents.

Selecting the Job

A job–a single piece of work done as a part of an occupation–is made up of a sequence with separate steps or operations which together accomplishes a definite work goal. In school shops and laboratories, a job may be a project, an exercise, an experiment. Some jobs can be broadly defined in general terms, such as building a house, rebuilding an automobile engine or installing a power line. Jobs defined so broadly, however, are not suitable for job safety analysis. Similarly, a job can be narrowly defined in terms of a single operation, such as driving a nail, tightening a cylinder head bolt, or installing insulator pins on a cross arm. Jobs so narrowly defined are not suitable for job safety analysis. Jobs suitable for a JSA are those job assignments such as a shop or laboratory teacher might make. Stacking building lumber, reboring engine cylinders, or setting power poles on new construction are good subjects for job safety analysis. They are neither too broad nor too narrow. In selecting jobs to be analyzed for hazards or potential accident sources, the teacher should be guided by the following factors:

1. **The frequency of the accidents that the job has produced in the past.** The greater the number of accidents associated with the job, the greater the need for JSA.

2. **The severity of the injuries that the job has produced in the past.** All jobs that have a history of disabling injuries should be given a JSA.

3. **The injury-severity potential of the job.** Some jobs may not have history of disabling injuries, yet they may have the potential for disabling or serious injuries. These jobss are candidates for JSA.

4. **The recentness of the job.** Newly established jobs created by changes in equipment, processes, or the program of instruction will not have a history of accidents, but may have accident potential not recognized by the teaching staff. Such jobs need an immediate JSA.

Breaking the Job Down

Before beginning the search for hazards and potential accidents, the teacher must break the job down into a sequence of steps or operations. In the field of vocational education this is known as "job analysis" and is a necessary procedure for determining course content. The steps should describe what is being done and should be listed in the order of occurrence. Details should be omitted. The following rules may be employed in determining the style to be used and preparing the descriptive statements:

1. A terse, direct style should be used.

2. Each statement should begin with a functional verb.

3. The present tense should be used throughout.

4. All words that do not impart necessary information should be omitted.

Here is an example of a step-by-step breakdown of a job in the occupation of power lineman— "setting poles in new construction:"

1. Raise pole with derrick on line truck.

2. Use cant hooks to control turning of pole.

3. Lower pole butt into pole hole.

4. Turn pole with cant hooks for proper alignment.

5. Support pole with pike poles at right angles.

6. Plumb pole with a plumb line.

7. Back-fill hole with earth.

8. Tamp earth around hole.

9. Remove pike poles and winch line.

The teacher can turn to several sources for information to assist him in making an analysis of a job. Chief among these are:

1. A personal background of work experience in the job.

2. Observation of others who are working at the job.

3. Consultation with individuals who have had considerable experience in doing the job.

4. A study of other job analyses.

5. A study of trade books.

6. A study of trade periodicals.

7. A study of manufacturers' manuals and handbooks.

There are two common errors made in breaking a job down into its basic operations. One is to make the breakdown too detailed, resulting in an unnecessarily large number of job steps, many of which may not be basic. The other common error is to make the job breakdown too general, resulting in the omission of important steps.

Identifying the Hazards and Potential Accidents

The third step in making a job safety analysis is the analysis of each of the job steps for purposes of identifying hazards and potential accidents. The goal is to determine the presence of *all* real and potential hazards and whether they result from the environment or the job procedure. The teacher should look for specific types of possible accidents. For each step in the job he should answer the following questions:

1. Can the students strike against, be struck by, or otherwise make an injurious contact with, an object?

2. Can the student be caught in, on, or between objects?

3. Can the student slip or trip? Can he fall on the same level or from one level to another?

4. Can the student strain himself by pushing, pulling, or lifting?

5. Does the environment present a potentially hazardous exposure to gases, vapors, mists, fumes, dusts, heat, cold, radiation, noise, or to hazardous substances which are flammable, toxic, corrosive (to living tissue), irritating, strongly sensitizing, radioactive, or which may generate pressure through heat, decomposition, or other means?

If the answer to any of the above questions is "yes," the analyst should record the specific hazard which might result in accidents. Two kinds of information are needed: the type of accident and the agent involved. The type of accident could be recorded in an abbreviated form such as:

1. SB–struck by
2. CBy–contacted by
3. SA–struck against
4. CW–contact with
5. CBe–caught between
6. CO–caught on
7. CI–caught in
8. FB–fall-to-below
9. FS–fall-same-level
10. O–overexertion
11. E–exposure

Developing Solutions

The final step in job safety analysis is to discover ways and means to eliminate hazards and prevent occurrence of the potential accidents. For each of the recorded hazards the teacher should ask himself the question: How should the student perform the job-step to avoid the potential accident, or what should he do or not do to avoid the accident? Possible answers should then be recorded for each step in the job sequence. Principal solutions include the following:[12]

1. Find an entirely different way to do the job.

2. Change the physical conditions that create the hazards.

3. If changing the physical conditions does not eliminate all the hazards, revise the job procedure.

4. Reduce the frequency of the job by correcting the conditions that make it necessary.

Recording the Job Safety Analysis

A job safety analysis can be recorded several ways. A printed form similar to the one shown in Appendix G could be used. This is an industrial-type work sheet but could be modified for school use. The teacher could design his own recording device. One method would employ 8½ x 11 in. paper divided into three equally spaced columns along the 11 in. side of the paper. In the left-hand column the basic steps of the job are listed in the order which they occur. The center column contains the descriptions of the hazard or potential accidents associated with each job-step. The right-hand column includes the recommended safe job procedure, again associated with each of the hazards or potential hazards listed in the center column.

Another method employs three color-coded 5 x 8 in. cards: A white card lists the job steps; a pink card lists the associated hazards; a green card lists the possible solutions. The cards, of course, are identified with the name or code number of the job. The reverse side of the card can be used for jobs requiring lengthy descriptions. These cards are then filed systematically, with the "action" or solution cards easily identifiable in safety green to remind the teacher that "here are steps which I must take to ensure the safety of my students and myself."

Benefits and Uses of Job Safety Analysis

The major advantages of a hazards analysis come after the task is completed. However, there are many benefits derived from the analysis procedure itself. While making a JSA, teachers learn more about the jobs they assign to their students. When students participate in job safety analysis, their attitudes are improved and their knowledge of accident prevention is increased.

The teacher benefits primarily from JSA in the discharge of the following responsibilities:

1. Giving individual instruction to students.

2. Making student safety contacts.

3. Orienting new students to the shop or laboratory situation.

4. Preparing for planned safety observations.

5. Giving pre-job instructions on infrequent or irregularly scheduled jobs.

6. Reviewing job procedure after accidents occur.

7. Studying jobs for possible improvement of technique and procedures.

SAFE USE OF INSTRUCTIONAL EQUIPMENT AND MATERIALS

The safe actions of students can insure the effectiveness of an accident prevention program in school shops and laboratories. Safe action implies acting safely under all circumstances, performing routine tasks in a safe manner, anticipating *and* overcoming physical hazards and unsafe acts of individuals in new and unfamiliar circumstances. The Metropolitan Life Insurance Company says that, "education to prepare such people includes four aspects: *habits, skills, knowledge,* and *attitudes.*"[13] *Habits* of safe living are learned at the same time that students learn other shop and laboratory skills; *skills* of accident prevention are perfected along with the development of manual skills; *knowledge* of an occupation equips a student to combat its hazards, and knowledge of accident patterns makes them aware of potential dangers; favorable *attitudes* are derived from the concern and enthusiasm for accident prevention displayed by school administrators, supervisors, faculty, and student leaders, from a great variety of learning experiences, and from the positive rather than the negative approach toward accident prevention.

School administrators, supervisors, and teachers have clear-cut responsibilities for the success of accident prevention. In particular, the teacher should never allow his responsibilities to be abrogated by any administrative delays. Likewise, the student has responsibilities to his teachers, his fellow students, and to himself which are manifested through the safe use of instructional equipment and instruction materials. There are many such responsibilities or practices. Among these student practices are the following (it must be noted, of course, that safe practices of students are also safe practices of teachers):

1. Keep all hand-tools sharp, clean, and in safe working order.

2. Report any defective tools, machines, or other equipment to the teacher.

3. Retain all guards and safety devices except with the specific authorization of the teachers.

4. Operate a hazardous machine only after all other students are clear of the machine.

5. Operate a hazardous machine only after receiving instruction on how to operate the machine safely.

6. Confine long hair before operating rotating equipment.

7. Wear appropriate eye protection wherever there is any danger from flying or falling particles or chips, radiation, glare, or hazardous substances in the work or environment.

8. Wear approved respiratory protection where harmful dusts or fumes exist.

9. Wear shop clothing appropriate to the instructional activity being performed.

10. Remove ties when working around machine tools or rotating equipment.

11. Remove rings and other jewelry when working in the shop.

12. Participate in no horseplay, practical jokes, or running in the shop or laboratory area.

13. Report all accidents to the teacher regardless of nature or severity.

14. Turn off the power before leaving a machine tool.

15. Make sure that all guards and barriers are in place and adjusted properly before starting a machine tool.

16. Recognize the distinctive sound of a properly adjusted and smooth-running machine tool.

17. Develop a respect for machine tools and understand their purpose.

18. Use soap and water frequently as a method of preventing skin diseases.

19. Operate an internal combustion engine in a shop area only if the exhaust is connected properly to an approved ventilation system.

20. Disconnect the power from machine tools before performing the maintenance tasks of oiling or cleaning.

21. Use a solvent only after determining its properties, what kind of work it has to do, and how to use it.

22. Put tools, repair parts, or other objects in their proper place when not in use.

23. Protect the cord of a portable electric hand tool from oil, hot or rough surfaces, and chemicals.

24. Clean the chips from a machine with a *brush—not with a rag or the bare hands.*

25. Wear suitable gloves or hand pads when handling sharp, heavy, rough, or hot materials and chemicals.

26. Use metal containers for oily waste or oily rags.

27. Operate a machine tool only after being sure that the footing is good.

28. Keep the shop or laboratory floor clear of scraps and litter and wipe up immediately any liquids spilled on the floor.

29. Give undivided attention, when operating a machine tool, to the task being performed.

30. Avoid using wrenches which do not properly fit the nuts, bolts, or other objects which they are being used to turn.

FACILITY DESIGN AND LAYOUT

Although the individual school administrator, supervisor, or teacher rarely has the opportunity of participating in the design or layout of a new school shop or laboratory facility, there is no reason for ignoring this important problem. Changing course content, rising enrollments, new materials, developing processes, and equipment additions require that existing facilities be under constant scrutiny and modifications be made as needed. Although there seems to be no information available concerning the relationship between accident frequency and school shop or laboratory design and layout, there does seem to be general agreement among educators that the manner in which such facilities are planned can have a direct bearing on accident prevention. The planning elements which should be considered are:

1. Space allocation.
2. Lighting.
3. Ventilation.
4. Personal service facilities.
5. Selection of machine tools and hand tools.
6. Placement of equipment.
7. Special hazards.
8. Traffic flow.
9. Safe access.

Space Allocation

Total space requirements for school shops and laboratories are generally expressed in terms of square feet per student. Recommendations vary with the nature of the activity and the grade level at which it is being taught, from a high of 100 to 150 square feet per student in senior high school auto mechanics classes down to 50 to 100 square feet per student in junior high school drawing classes. This approach is a convenient point of departure for planning, but in order to insure maximum safety for students, each school shop or laboratory must be analyzed with the view of providing adequate space for the specific items of equipment and special hazards in each shop.

As a general rule, all machines, benches, and laboratory equipment should be surrounded by a minimum of three feet of open space. However, certain machines such as cut-off saws, shears, jointers, planers, drill presses, and lathes may need considerably more space to accommodate the long materials which are ordinarily processed with these machines. Major aisles should have a minimum width of four feet, while the allowance for secondary passageways should be three feet. Sufficient open floor space to prevent crowding and interference among students must be provided around all doorways, in project assembly areas, demonstration areas, around the tool crib or tool panels, and near material storage areas. Overhead obstructions such as pipes, duct work, and cranes should have a minimum of seven feet clearance between the lowest part and the floor level. Machines that are more than four feet in height should be placed toward the outside of the layout in order that visibility in the shop will not be obstructed.

Lighting

The problem of natural and artificial lighting for school shops and laboratories is one which involves the school architect and lighting engineer during the planning and building phases of school plant construction. The school shop planner is rarely involved either as an advisor or a consultant in such a highly technical undertaking. He is, however, involved in determining lighting equipment needs for local and special illumination requirements. These include: 1) adjustable lamps for illuminating the point of operation on hazardous machines; 2) portable lamps to provide temporary illumination for projects requiring supplemental lighting; 3) flexible lamps for fine precision bench and machine work; and 4) specialized supplemental lamps for fine and extra-fine inspection processes.

Ventilation

It is generally agreed that ventilation is of great importance in the environment of individuals. It is known that certain diseases are airborne, and that air contaminated by dust, gas, fumes, smoke, vapors, or odors can cause discomfort, sickness, and death. An even more insidious effect of improper ventilation in school shops and laboratories may be the loss of alertness on the part of students which causes them to commit unsafe acts. There is a definite relationship between proper ventilation, comfort level, and the frequency of accident occurrence.

School shop personnel must be concerned both with general room ventilation and special local exhaust ventilation. The subject of ventilation can be quite complex, and the technical considerations involved usually require the services of a heating and ventilating engineer to assure that proper methods and controls are used. However, the effectiveness of original installation is sometimes changed because of building alterations or additions and the introduction of processes or equipment not considered in the initial planning. Also efficient systems sometimes malfunction and school administrators, teachers, and students should be constantly aware of the conditions and changes in the atmospheric environment.

General ventilation is accomplished by introducing fresh outdoor air into school shops and laboratories at the rate of 15 to 30 feet per minute. Although in some cases outside windows are adequate, general ventilation is commonly accomplished by blowers or exhaust systems. Air movement should not be more than 25 lineal feet per minute during the heating season and 100 lineal feet per minute during warm weather.

Special local ventilation is accomplished through individual exhaust systems installed where work activities are carried on which ordinarily result in contamination of the air. The type of local system chosen will vary with the conditions, but in general, permanent work stations require permanent installations, while portable or flexible systems are useful when portable equipment is involved. Some of the school shop activities which require special ventilation are welding, foundry, forging, heat treating, machining cast iron, machine woodworking, auto mechanics, machining of plastics, grinding, electroplating, anodizing, etching, painting, spraying, making blueprints, and machining activities using cutting oil for coolant. Chemical laboratories usually require specially designed exhaust hoods.

Personal Service Facilities

Good personal service facilities within school shop or laboratory areas can do much to maintain student health. A sanitary drinking fountain should be installed at a convenient location. If cooled by mechanical means, the temperature of the water should not be lower than 45° F, but below 60° F. In hot weather it is advisable to provide containers of salt tablets at the fountains.

At least one wash basin, two feet of trough, or a circular or semi-circular wash fountain with hot and cold running water, preferably from a combination supply fixture, should be provided within the work area for every twenty students. The proper type of soap in an adequate dispenser is important not only for odinary hygiene but as a protection against dermatitis. Individually dispensed paste, liquid, or powder–not bar soap–should be provided for common use. Paper towels in covered dispensers with a closed disposal receptacle should be located close to the washing facility. In chemical laboratories where hazardous substances are handled, deluge showers, and emergency eye wash fountains should be provided in the immediate vicinity of the hazard.

Lockers in the shop room should be perforated and large enough to permit clothing to be hung up to dry. Lockers should have sloped tops to prevent material from being stored on the tops, and they should be firmly fastened to the floor to prevent overturning.

Selection of Machine Tools and Hand Tools

In general the safest machine is the best machine available to do the job. A safety check list for use in selecting machine tools might well include the following questions:

1. Is the machine designed so that it is impossible for the student to be exposed to the point-of-operation or any other hazard point while the machine is operating?

2. Is the machine designed so that, wherever possible, all corners are rounded and no sharp corners or edges are exposed?

3. Are the machine controls located so that the student will not be near the point-of-operation while operating the controls?

4. Are the controls placed so that the student will not have to reach excessively or be off-balance to operate the machine?

5. Are the power transmission and drive mechanism built in as integral parts of the machine?

6. Are overload devices built into the machine?

7. Is the machine designed for mechanical rather than manual holding devices?

8. Are all electrical components of the machine grounded?

Because of highly competitive marketing, manufacturers of machine tools find it advantageous to list safety devices designed for the protection of operators as auxiliary equipment. It is important that school shop personnel be familiar with such items and convince the school business office of the importance of their inclusion in the original purchase order. If adequate guarding is not provided on machinery by the manufacturer as standard equipment, this does not relieve the school of its responsibility for proper guarding.

Attention must also be given to the quality of materials and construction of the many hand tools purchased for the school shop. The quality-built tool is the safe tool, and quality must not be sacrificed for the sake of the budget. Electric hand tools must be equipped with ground wires, and all connections, plugs, terminals, and wires should be checked before acceptance to see that all are of approved construction.

Placement of Equipment

Previous mention has already been made of providing adequate space around equipment. However, care must be taken to locate equipment in such a way that there is no interference between the operations and the operators. Machines should be placed at a 45 deg. angle to window walls in order to secure the maximum effect from natural light. The angular placement will also position the operators out of alignment with the revolving spindles of the machines adjacent to them, thereby, reducing the danger from accessories or materials which may be thrown from neighboring equipment.

The maximum size of materials to be worked in a machine should be determined, since additional space may be needed. A lathe to be used for machining long bars fed through the head stock obviously needs more space to the left of the machine than one which is to be used only for chuck work. Certain machines, such as the metal working planer and shaper, need to be placed so that sufficient clear space remains when tables or rams are operating at their maximum distances. All heavy equipment should be leveled and securely fastened to floors. The placement of felt, cork, rubber, or other shock-absorbing material under machines is recommended in order to reduce the noise level. Certain machines, such as cutoff saws and shears, should be placed near the material storage areas in order to reduce hazards from handling large pieces of stock.

Methods used in placement of equipment usually involve scaled drawings of floor plans indicating fixed obstructions such as supporting pillars in walls, window and door openings, and relationship of the room to other service areas. Showing the relative location of all equipment and facilities on a drawing is known as the "single dimension method." The "two-dimensional method" is probably most frequently used and involves arranging on the floor plan drawing flat patterns made to scale and in the shape of the floor area required for each item of equipment. A more revealing technique is to make use of three-dimensional scale models of equipment set up on a drawn-to-scale floor plan. Some equipment manufacturers furnish models upon request, and other models may be carved from soft wood, or made from cardboard. The planner should make several alternative layouts before deciding which will be implemented. It may be found that the introduction of a single item of equipment will demand the rearrangement of the entire floor plan, but additional equipment or a change in emphasis or procedure will require adjustment of the layout without jeopardizing the safety considerations already in effect.

Special Hazards

In almost every shop there are certain pieces of equipment, kinds of materials, or specific processes that deserve extra attention for the protection of students. In many instances, special shielding of certain equipment and isolation of hazardous processes are required. Welding areas must be isolated for the protection of students from flash, burns, and fumes. Foundry and heat-treating areas should be located so as to avoid injury to students. Hand chipping of metal and machining operations that result in flying chips require isolation or special shielding. Areas such as electro-plating and etching where acids and chemicals are used need precautionary treatment. Paint and pray areas demand an efficient exhaust ventilation system, as well as an isolated location. An exhaust system is also needed wherever auto or other engines are running. The relatively high speeds of portable and stationary grinding machines and the possibility of wheel breakage require the segregation of these machines from others in the shop.

Special mention should be made of the care needed in handling compressed air and gases. It is especially desirable that oxygen and gas welding tanks are stored outside the school building. Other hazards that should be noted involve the handling and storage of toxic, flammable, or volatile materials such as gasoline, kerosene, naptha, and various oils, paints, varnish. These require special precautions in their storage and use. Compatible storage of reactive chemicals must also be taken into consideration.

Individual electric power control should be standardized on all equipment and located for the convenience of the operator. A central master control is of great importance. It should be conspicuously marked, have provision for locking, and be readily accessible to the instructor. All electrical equipment should be grounded.

It is probable that many school shops and laboratories may soon be faced with the special hazards of ionizing radiation. Many precautions need to be taken when and if radioactive materials or radiation-producing devices are introduced to the school. It is a fairly safe assumption, of course, that the layout of shops will require revision.

Traffic Flow

Because of the nature of school shop and laboratory work, there is necessarily some student movement within the area. Certain areas are commonly visited by students one or more times during a class period. Provisions should be made for traffic between the work stations and these areas without the danger of exposure to hazards or interference with the work of others. Examples of such areas include: tool cribs, tool panels, planning and study areas, material storage areas, lockers, drinking fountain, wash-up areas, teaching center, and general equipment such as tool grinders and drill presses. Well marked aisles help to accommodate travel to and from these areas and keep congestion at a minimum.

Safe Access

Failure to provide safe access to every point in a school shop or laboratory is responsible for many serious accidents. In order to realize the importance of such a provision, the "safety" planner, for example, should accompany the "maintenance or repair student" often enough to keep informed of the potential hazards which he faces in his assigned work. Failure to provide safe access affects the safety of individuals doing such work as window cleaning and building repairs, overhauling and repairing of overhead electrical equipment, and work on equipment located in out-of-the-way places.

MANUAL HANDLING AND STORAGE OF MATERIALS AND TOOLS

Although the problems involved in the manual handling of materials and the storage of materials and tools are somewhat related in terms of accident prevention in school shops and laboratories, they will be treated separately in this section of this publication.

Manual Handling

Accidents in manual handling of materials by students are primarily the result of unsafe working habits–improper lifting, carrying too heavy a load, incorrect gripping, and failing to wear personal protective equipment. Training in safe work habits, breakdown and study of job operations by the teacher, and adequate supervision can help to minimize these accidents.

Lifting

"It's not what you lift but how you lift it." This statement applies to the lifting, lowering, or moving of heavy equipment or loads. Periodic demonstrations should be given by the teacher in "how to lift a heavy object" using the following procedure prescribed by the National Safety Council;[14] the reverse procedure is followed for lowering the load.

1. First make a preliminary "heft" to be sure that the load is easily within your lifting capacity. If it is not, secure help.

2. Set your feet solidly and well apart, one foot slightly ahead of the other. In some cases, it might be easier to go down almost to the floor on one knee while keeping the other leg at a 90 deg. angle.

3. Crouch as close to the load as possible with legs bent at about a 90 deg. angle at the knee.

4. Keep the back as straight as possible, it should not be arched.

5. Get a firm grip on the object, lifting one end slightly if necessary to get one hand under it. Grip the load so that it will not slip while you are lifting and carrying it and so that your hand will be protected.

6. To lift the object, straighten your legs, keeping your back erect and your head up. Looking at the ceiling as you start the lift will pull your back straight.

Team Lifting and Carrying

When two or more students must carry a single heavy object, they should be similar in size and physique. One acting as a leader should position himself so that he can watch and coach the others. He should use predetermined signals to control the lifting, carrying, and setting down of the object. All students should act together so that no extra burden will be placed suddenly upon one student.

When two students carry long sections of pipe or lumber, they should carry on the same shoulder and walk in step. Shoulder pads will prevent cutting of the shoulders and help to reduce fatigue.

Storage of Materials and Tools

The safe storage of materials and tools is directly related to effective teaching and instruction, good housekeeping activities, fire prevention procedures, and other elements of a safe school shop environment. Inadequate or unsafe storage procedures and practices frequently create hazardous environmental conditions dangerous to students working in the shop and create fire or explosion hazards that might damage the building. Lack of storage facilities invites unsatisfactory housekeeping practices and increases the difficulty of handling materials, tools, and projects, thereby increasing the accident-producing hazards in the shop.

Safe storage facilities for materials and tools are provided in school shops for several reasons. The primary purpose is to protect students and other persons working in the shop from accidents. Adequate storage facilities are also needed to protect tools and materials from theft, unauthorized use, improper or unsafe handling, breakage, and deterioration. Lack of adequate storage areas for tools and materials creates many unsafe conditions which cause accidents. Unsafe acts may be committed by shop students because of insufficient storage space. Efficient storage practices will enable the teacher to keep an accurate up-to-date inventory of materials and supplies in the shop.

Many storage problems could have been eliminated in the planning stages of the building or school shop. However, storage arrangements frequently are completely omitted from the original layouts of shops, or if included, such space as is provided is inadequate, inflexible, and arranged with little allowance for growth or expansion of the shop facilities. No one storage method or procedure is best for all shops or conditions, but from the standpoint of efficiency and safety the shop or laboratory teacher can follow certain general considerations in arranging for the safe storage of shop tools and materials.

Location of Storage Facilities

The general location of storage rooms may depend upon the size of the shop or laboratory, the nature of the activities, class enrollments, and nature of the materials and tools. Generally, storage rooms should be located adjacent to the work area and close to places where the student will need materials. Supply storage areas should be located in or near the shop, so that the students have easy access to materials without having to cross the paths or traffic patterns of other students. Safety and ease of storage, delivery of supplies, and the issuing of materials should be considered when planning the location of storage facilities. It is desirable to have an outside door or unloading ramp near the storage room. Storage areas should be arranged and located to reduce traffic and eliminate congestion during the class period. Crowded areas are prolific accident producers. Tool panels and cabinets should be located away from hazardous machinery. Supplies of flammable liquids should be stored in an area apart from the main building. The storage facility for flammable liquids and other materials should be located so that the sun's rays and other sources of heat do not reach them. Chemicals which may react with one another, if spilled, should be stored separately in compatible groups.

Construction Considerations

Shelves, racks, bins, and cabinets should be designed and constructed to hold the maximum number of tools and items safely without the danger of collapsing. Storage racks constructed with steel or pipe are usually safer than those built of wood and create fewer fire hazards. Extra-strength racks may be needed for large portable tools and other heavy items. Racks should be designed so that heavy items are stored on the bottom shelves.

Storage Methods

All materials, tools, parts, and accessories should be stored safely and neatly and arranged in an orderly and accessible way in the places provided, regardless of the specific storage method. Those items used most frequently should be stored within easy reach on the lower shelves. Storage areas must be clean, orderly, ventilated, and well-lighted. Containers, bins, shelves, and drawers which contain caustics, liquids, acid solvents, and bundles of materials should be clearly labeled. Supplies and materials should never be stored on the tops of lockers or cabinets, because there is always the danger of objects falling from these places. Generally, vertical storage of long pieces of material creates greater hazards than horizontal methods of storage.

Tool Storage

Many different methods and techniques have been devised for storing hand and portable tools. The most common tool storage methods are tool panels, centralized tool cribs, wall cabinets, bench drawers, and movable racks. Regardless of the methods selected by the teacher, tool storage facilities should be designed and arranged to provide maximum protection to students and shop workers. Many accidents have been caused by tools falling from overhead, by knives and other sharp tools being carried in pockets, and by chisels laid loosely in tool boxes.

Materials Storage

The average shop contains hundreds of different hardware items and supplies. Each presents a different storage problem. Regardless of the system used, the storage facilities should be well located for convenience and safety. Many shop teachers use the closed storage method, in which all supplies and materials are kept locked in the storeroom or cabinets. Other teachers use the open storage methods, where students are permitted to use supplies as they are needed. A combination of the open and closed systems of materials stored are used by most teachers. For safety reasons, some materials, particularly hazardous chemicals, should be kept under lock and key and used only under the immediate supervision of the teacher.

Flammable Liquids and Finishing Supplies

The storage of flammable liquids, such as gasoline, thinners, benzene, and other liquids, presents many problems from the standpoints of convenience, fire control and prevention, health of students, and explosions. The storage of such materials can be very troublesome and dangerous unless flammable liquid storage areas are carefully planned and provisions made to safely care for the various types of flammable materials.

MACHINE GUARDING

Machine guarding protects against injury to individuals from the following sources:

1. Direct contact with the moving parts of a machine.

2. Work in process, *i.e.* kickbacks on circular saws, metal chips from machine tools, splashing of hot metal or chemicals, etc.

3. Mechanical failure.

4. Electrical failure.

5. Human failure, resulting from curiosity, zeal, distraction, fatigue, indolence, worry, anger, illness, deliberate chance taking, etc.

This section will be limited to a discussion of the first three sources. They are commonly classified as "mechanical hazards." Mechanical hazards may be further classified into two general categories: 1) power transmission hazards, and 2) point of operation hazards.

Power Transmission Hazards

Power transmission apparatus includes shafting, belts, pulleys, couplings, keys, collars, set screws, gears, and prime movers. The motions and actions which result in hazardous exposures in the transmission of mechanical power are classified as: 1) rotating motions, 2) reciprocating motions, 3) transverse motions, and 4) in-running nip points.

Rotating Motion

A rotating shaft is a good example of rotating motion. It may be smooth or rough; it may rotate slowly or rapidly; it may be of small or large diameter. Regardless of its characteristics, it is hazardous when it is revolving. Shafting which appears to be smooth can grip clothing and cause serious injury. A revolving shaft may be vertical or horizontal–a lead screw on a lathe or the spindle of a drill press. The hazard increases if pulleys are mounted on the shaft or if collars, couplings, or projecting keys are installed.

Reciprocating Motion

This motion is best described as the back and forth motion of a ram, such as might be found on a metal-working shaper or the bed of a surface grinder. There are two points of danger: 1) the point where the moving part approaches or crosses the fixed member, and 2) the point of the pinch. This pinch point would be found at the end of the back motion of a ram, where an individual could be crushed between the moving part and a wall or column.

Transverse Motion

This motion is produced by a transmission belt which passes over a pulley and has its direction changed 180 deg. In doing so, nip points are created where the belt and the pulley come in contact. The motion is quite common to large power transmission belts and pulleys as well as to belt sanders.

In-running Nip Points

This hazard is created whenever machine parts rotate towards each other or where one machine part rotates toward a stationary object. Objects or parts of the body may be drawn into this type of nip point and be severely bruised or crushed. The in-running side of rolling mills, rolls used for bending, printing, corrugating, embossing, feeding and conveying of stock, the in-running side of a chain and sprocket, a gear rack, and a gear and pinion are examples of in-running nip point hazards.

Point-of-Operation Hazards

Point-of-operation hazards are present at the cutting point of a machine and are created by the processes of sawing, drilling, grinding, turning, printing, planing, sanding, forming, punching, shearing, and shaping. Each machine used in school shops to perform these processes offers a unique accident prevention problem at the operating point. The following are some examples of these machines:

Circular Saw

This machine is designed to permit a wide variety of operations including cross-cutting, ripping, and dadoing of wood stock. There are two principal types of accidents connected with its operation: 1) contact with the rotating blade by the operator, and 2) kickback of material striking the operator.

Jointer and Planer

Both of these machines, used extensively in school shops, utilize knives mounted on steel shafts and rotating at high speed to provide a planing or surfacing action on wood stock. The jointer is the more hazardous of the two machines since the knives are easily uncovered, exposing the operator to blade contact. Planer knives are relatively well shielded during the machine's operation, making the operator less vulnerable to contact with the rotating knives.

Band Saw

Injuries from this machine are usually less severe than those of the circular saw, jointer, or planer. The feeding of wood stock, however, is usually accomplished free hand, bringing the operator's hands very close to the fast-moving saw blade.

Shaper

This can be an extremely hazardous machine which requires careful use by the student under the close supervision of the teacher. The nature and location of the cutting knives, the very high operating speeds, and the small size of the wood stock often used make the machine very difficult to guard.

Portable Power Saw

All portable power tools can be considered as special types of hand tools, powered by air or electricity, which introduce certain special hazards to the shop student. The portable circular power saw, however, offers the greatest point-of-operation hazard, since the teeth of the blade must be exposed during the woodcutting operation.

Metalworking Machine Tools

Machine tools used to perform metalworking operations are difficult to guard at the point-of-operation and offer many extreme hazards. Injuries from these machines include those caused by students coming in contact with moving cutters, rams, dies, or stock, and by flying chips.

Other Metalworking Machines

Such machines may range from small bench machines to the large pressing, stamping, and forging machine. Their power may range from foot and hand operation to electric and hydraulic power. Regardless of the nature of the driving power, all machines involving moving parts need guards against hazards at the point-of-operation.

Paper Cutter

Hand- or foot-powered operated "guillotine" paper cutters are found in the graphic arts areas of school shop programs. The principal type of accident on these machines involves injury to the operator's hands by the blade during the cutting process.

Hand-fed Printing Press

Most school print shops are equipped with one or more hand-fed platen printing presses. The hazard on this machine centers in the "feed" area, where the paper is introduced into the press with the hands. Accidents are caused by the hands or fingers being in the impression zone during the printing operation, often resulting in painful and crippling injuries.

Type of Guards

Three types of guards are common to both power transmission guarding and point-of-operation guarding: 1) fixed, 2) interlocking, and 3) automatic. A manufactured or a home-made guard may be purchased or constructed with one or several of these characteristics.

Fixed Guards

A fixed guard is one which is secured in a permanent stationary position around the dangerous parts. The fixed guard is preferable to all other types of guards and should be used in every case unless it is definitely impracticable. Its advantage is that it prevents access to the danger points of the machine by completely enclosing the hazardous operation at all times. It also serves in many cases to prevent bursting parts from flying about. Specific power transmission parts commonly guarded by enclosure guards or fixed guards include horizontal shafting, belts, and pulleys, couplings, shaft ends, and sheaves. These guards are commonly used in connection with barriers for guarding large pulleys and inclined belts.

Interlocking Guards

Interlocking guards are considered the first substitute for the fixed guard. They may be actuated mechanically, electrically, pneumatically, or by a combination of these means, and they prevent operation of the machine until the guard is moved into position. These guards are designed so that if the machine is in operation and the guard is opened or the barrier is crossed or dropped, the machine will come to an immediate stop. The machine cannot be started unless the guard is in its proper position. An effective interlocking guard must satisfy the following three requirements: 1) it must guard the hazardous part before the machine can be operated; 2) it must stay closed until the hazardous part is at rest; and 3) it must prevent operation of the machine if the locking device fails.

Automatic Guards

An automatic guard is one that operates independently of the operator and repeats its actions as long as the machine is in operation. Only after the operator's hands, arms, and body are removed from the danger zone can the machine operate.

Summary of Guard Requirements

The following points should be considered as requirements for acceptable machine guards:

1. They must conform to the standards of the United States of America Standards Institute and the State Inspection Department having jurisdiction over the school shop.
2. They must be considered by the instructor and student as a permanent part of the machine or equipment.

3. They must be designed and constructed to afford maximum positive protection to all people working on or around the machine.

4. They must prevent access to the danger zone while the machine is in operation.

5. They must not weaken the structure of the machine.

6; They must not interfere with the efficient operation of the machine or cause discomfort to the operator.

7. They must be designed for the specific job and the specific machine, with provisions being made for oiling, inspecting, adjusting, and repairing of the machine.

8. They must be durable, resistant to fire, wear, and corrosion, and easily repairable without sacrificing the effectiveness of the guard.

9. They must be strong enough to resist normal wear and shock and to withstand long usage with minimum maintenance.

10. They should not in themselves present hazards such as splinters, pinch points, shear points, sharp corners, rough edges, or other sources of injury.

11. Whenever possible, guards should be interlocked so that the machine will not operate unless the guard is giving maximum protection.

12. They should be painted to conform with the USASI color code recommendations.

The student who works around mechanical equipment or serves as an operator of a piece of machinery must develop and maintain a respect for safeguards. No deviation from the following safe work practices should be tolerated:

1. No guard should be adjusted or removed for any reason by anyone unless: a) specific permission is given by the teacher, b) the person concerned is specifically trained, and c) machine adjustment is considered a normal part of the student's task.

2. No machine should be started unless the guards are in place and in good condition. Defective or missing guards should be reported to the teacher immediately.

3. Whenever safeguards or devices are removed to repair, adjust, or service the equipment (lubrication and maintenance), the power for the equipment should be turned off and the main switch locked and tagged.

4. Students should not be permitted to work on or around mechanical equipment while wearing neckties, loose clothing, watches, rings, or other jewelry.

School administrators and shop teachers should avail themselves of the excellent publications dealing with the subject of machine guarding. These publications are the United States of America Standards Institute's *American Standard Safety Code for Mechanical Power Transmission Apparatus* and *The Principles and Techniques of Mechanical Guarding,* Bulletin No. 197 of the Bureau of Labor Standards, U.S. Department of Labor.

Maintenance for Safety

Maintenance is an important aspect of accident prevention in school shops and laboratories which is often overlooked. In addition to assuring maximum operation of equipment and facilities at a minimum cost, proper maintenance will provide the safest possible working conditions for students and instructors. Unsafe conditions are at times due to insufficient or improper maintenance and result in accidents causing injuries to students, costly property damage, or both. Instances in which poor maintenance can lead to accidental injury or damage to equipment are numerous. The following are typical examples:

1. Floor maintenance, *i.e.*, roughness, slippery from wear, holes, splinters, and poor patching, contribute heavily to the sources of injuries that are numerically most important–namely, handling, slipping, tripping, and falling. Such defects also often contribute to "machinery" injuries.

2. The condition of all portable equipment that students climb or stand on or work from, is important from a safety standpoint. These include portable ladders, steps, saw horses, scaffold, planks, etc.

3. Defective tools are prolific sources of injury. This applies not only to familiar hand tools such as chisels and wrenches, but also because of their increased use, to power hand tools such as grinders and drills.

4. Unless properly maintained, machine guards and safety devices not only fail to protect but also give a false sense of security which may be worse than no protection at all.

5. A higher standard of maintenance than is necessary for educational purposes may be vital to safety. For instance, clutch wear may cause unexpected starting of a machine.

6. Electric wiring becomes unsafe not only from use but from temporary repairs, alternations, or additions. "Temporary" jobs tend to become permanent unless carefully limited to necessities and immediately made standard when the emergency has passed.

7. Windows, lights, and reflectors may become dirty, and light bulbs may be burned out.

8. The ventilation for the shop or laboratory may not be properly adjusted, with screen filters not replaced or the ventilator overloaded.

Maintenance can operate in two ways: 1) routine repetitive maintenance necessary on a day-by-day basis to keep equipment clean and operating, and 2) preventive maintenance which involves overhaul of equipment in one degree or another or on a predetermined schedule before breakdown occurs.[15] These two approaches to maintenance differ only in the way they operate, and some overlapping is usually involved. In fact, both types of maintenance may be carried out to a degree by student personnel.

Routine Maintenance

Routine maintenance is required primarily to keep equipment and the working area in the same operating condition without a major change. Routine maintenance is for the purpose of maintaining the status quo rather than detecting and correcting conditions which may cause future trouble. If the conditions are good, maintenance keeps them that way; if conditions are not good, routine maintenance will not improve them. When a condition is uncovered which points to future breakdown, it should be routinely repaired, but all too often repairs are made only after the breakdown occurs. Routine maintenance involves a variety of things—oiling of machinery, disposal of scrap, inspecting condition of tools, a general clean-up, minor repairs of machines and equipment due to breakdown, and similar activities.

The fact that maintenance is routine in nature does not detract from its importance, either in maintaining a training program or preventing injuries. It is an important activity, and a maintenance program will materially assist creating an efficient safe-working environment. But a good maintenance program should be planned and organized in the same way as any other activity. In planning and organizing, consideration should be given to at least these five steps:

1. Develop effective maintenance procedures to cover all maintenance activities.

2. Formulate schedules to cover repetitive operations, such as lubrication of machines, cleaning windows and lighting fixtures, and disposal of scrap.

3. Establish a procedure for handling non-repetitive jobs, such as repairs and installation of machines.

4. Arrange to have frequently needed spare parts on hand for equipment repair.

5. Develop a follow-up system to assure that procedures and schedules are followed.

The importance of routine maintenance should not be underestimated. When properly planned and organized, it can be a definite factor in controlling accidents in school shops and laboratories.

Preventive Maintenance

Preventive maintenance has a different purpose than routine maintenance. It aims to prevent conditions from arising which could result in costly delays due to the breakdown of equipment. Such conditions can be detected through inspection and prevented by periodic overhaul or replacement. A good illustration of preventive maintenance fundamentals is found in commercial airline operations. Close inspection of the aircraft is made after every trip. A more detailed inspection is made after a fixed number of hours, and a complete overhaul is given at the end of a specified number of flying hours. Extensive records are kept on the findings of such inspections, and the repairs or replacements are made on the basis of the needs indicated by the inspection. Many items are corrected upon report to the pilot, and most of them before malfunctions or failure occur. The inspection or overhaul provides a sound basis for scheduling work to avoid rush handling of emergency jobs involving excessive overtime.

Preventive maintenance may be defined as an orderly, uniform, continuous, and scheduled procedure to prevent breakdown and prolong the useful life of equipment and buildings. Some advantages to be gained from preventive maintenance include the following:

1. Decrease of "downtime" of equipment due to breakdown.

2. Reduced repair costs.

3. Increase in the life of the equipment.

4. More training time on the equipment available.

5. A safer working condition for students.

In determining whether a system of preventive maintenance is worthwhile, the following questions need to be considered:

1. Does the cost in inspection exceed the cost of repair and value of downtime?

2. Will the normal life of the equipment exceed the need without preventive maintenance?

3. Does the good condition of the equipment contribute to safe working conditions for the students?

4. Is the equipment critical to the training process?

5. Is standby equipment available for continuation of the training process in the case of a failure?

If the answer to questions 1, 2 or 5 is "yes," the need for preventive maintenance is doubtful. If the answer to 3 or 4 is "yes," the need is at once apparent. Under most conditions, preventive maintenance is necessary to maintain training facilities, and it is almost always necessary to eliminate dangerous conditions involving mechanical equipment.

Successful preventive maintenance in school shops and laboratories involves at least the following factors:

1. Regular systematic inspections of all machines, equipment, and premises.

2. A program of periodic replacement of essential equipment or parts.

3. Keeping records of inspections, replacements, and findings.

4. Repairs and replacements made as indicated from inspections or in accordance with replacement schedules.

5. Follow-through to evaluate the progress.

A preventive maintenance program, rather than a simple repair system, will result in considerable savings in training economies. It will also lessen the number of accidents. Many school injuries are charged to training hazards, but the true cause may often be poor maintenance; proper maintenance would have eliminated the hazard and consequently would have prevented the resulting accident. Unsafe conditions which lead to accidents frequently stem directly from failure to spot a threatened breakdown before it occurs. It promotes orderly and economic training; it controls equipment losses; and it helps improve training methods generally. Good maintenance also promotes proper utilization of tools, equipment, and machines. Adequate tool storage with inspection and dispensing procedures assures issuance of the right tool for the job, one properly dressed or sharpened, and in overall satisfactory condition. When safe and properly maintained tools are issued to students, they have an added incentive to give the tools better care. Preventive maintenance is a conservation program at the training level, a systematic method of saving which will return dividends in training and in accident prevention.

FIRE PREVENTION AND EXTINGUISHMENT

School administrators, supervisors, and teachers must be concerned with fire protection for students under their care. The combination of fire and explosion has resulted in the greatest of school disasters in terms of human and material loss. Those responsible for planning and operating school facilities should seek advice from their local fire department, fire insurance carrier, fire inspection bureau, Underwriters' Laboratories, National Safety Council, and appropriate state officials in order to assess the adequacy of their fire protection and control methods.

Understanding Fire

Four conditions must be present simultaneously in order for a fire to start and burn:

1. Oxygen must be present–air usually contains between 16 to 21 per cent of oxygen, with the average flame starting to extinguish below 16 per cent oxygen. In some cases, the oxygen is incorporated directly into a chemical and air is not necessary for burning to occur.

2. There must be a supply of fuel–any combustible material such as wood, paper, oils, etc.

3. The temperature of the fuel must be above the ignition point; ignition temperatures vary: wood–469 to 514 deg. F; newsprint paper–451 deg. F; pyroxylin plastic–275 deg. F; and cotton (duck)–439 deg. F.

4. A flame chain reaction exists—fuel molecules appear to combine with oxygen in a series of successive intermediate stages, called branched-chain reactions, in arriving at the final and end products of combustion. These intermediate stages are responsible for the evolution of flames.

To prevent or stop active fire, one of the four conditions listed above must be eliminated.

Four fundamental requirements must be operative in an adequate fire prevention, protection, and control program in school shops and laboratories: These are to: a) prevent the outbreak of fire, b) prevent the spread of fire, c) provide prompt detection and extinguishment of fire, and d) provide suitable exits and prevent panic.

Cause of Fire

Because the nature of school shop work requires the use of fire, heat and flammable or combustible materials, there are numerous sources from which flame may originate.[16] The general shop, where several different processes and materials are in use, is probably more vulnerable to fire hazards than the unit shop. Attention should be called to the following factors when planning for fire prevention:

Gas

Gas is used extensively in school shops as the fuel for brazing, heat treating, soldering, and melting furnaces. Gas equipment may leak or gas may escape because of faulty ignition in the appliance. Frequent inspection and the use of safety pilots and cut-off valves is essential where gas is in use. Special instruction must be given to students before they are permitted to light gas-fired torches or appliances.

Housekeeping

Housekeeping is inseparable from fire protection. Flammable and combustible materials should be stored in their proper place. Rubbish must not be allowed to accumulate on floors, in corners, or other niches. Waste material should be removed daily. Oil accumulation on floors or oil-soaked wood or porous floors may ignite if contacted by flame, sparks, or sufficient heat.

Electrical Equipment

Electrical devices and equipment which are improperly installed, worn, old, or poorly maintained may precipitate a fire. Short circuits causing arcing and heating sufficient to ignite flammable materials, an accumulation of oil or grease around motors, and the breakdown of insulation around old wiring are common causes of short circuits. Other causes may be found in the use of improper wire size, fuses too large for wire capacity, extension cords improperly used or maintained, and poor connections in the wiring.

Matches and Smoking

Common causes of fires in industrial plants which should be controlled in a school situation are matches and smoking. Smoking should be no problem in most school shops, since students are usually not allowed this privilege. However, it is known that custodians, teachers, and visitors sometimes smoke in shops during "off" hours. Of course, this should be prohibited. Matches present a different problem because they are used and carried by students. Only safety matches should be allowed in the shop, and whenever torches are to be lit, the safety, flint, or scratch type lighter should always be used.

Spontaneous Ignition

This form of ignition perhaps has been more common in school shops than in industry, due partially to lack of understanding by students and to the fact that combustibles are often left in one location for considerable lengths of time; *i.e.*, over weekends and holidays. Oily or paint-soaked rags and clothing left in student lockers are probably the greatest hazard. Other sources contributing to this hazard are rubbish and accumulation of dust, lint, and oil in duct work and flues. Safety metal containers with a self-closing lid must be used for the storage of oily or paint-filled waste and rags.

Open Flames

This is an obvious hazard which accompanies the performance of welding, soldering, forging, forming, and other heating operations. Fireproof materials such as steel plates and asbestos sheets should be installed around permanent equipment. The greatest hazards are present when portable equipment such as gas welders, blow torches, Bunsen burners, plumber's furnaces, and soldering torches are in use. Students must be given thorough instruction in the operation and care of such equipment. Open flames should not be left unattended. The immediate area where they are to be used should be cleared of flammable or combustible material, and the operator must use care in directing the flame in order to prevent burns to himself, others and adjacent material. Appropriate clothing should be worn in these types of operations.

Heated Surfaces

Heated surfaces are found on furnaces, flues, glue pots, hot plates, hot metals, and regular or infra-red light bulbs. These heated surfaces will cause fires if flammable or combustible materials are close enough to absorb heat sufficient to raise it to the ignition point. Building codes prescribe the minimum clearance between such surfaces and adjacent combustible materials. Surrounding areas should be kept clear of flammable material, and walls, bench tops, and ceilings near such surfaces should be covered with nonflammable materials. Occasionally a heated surface will develop from friction caused by slipping belts, hot bearings, or moving parts rubbing against guards, floors, or other stationary objects. The presence of oil, grease, or rubbish near these areas may result in a fire.

Molten Metal

Hot, molten metal from welding and foundry operations must be controlled through use of proper handling equipment in areas constructed from fireproof material. Nonflammable personal protective cloghing is required for students working in these areas. The danger from flying globules of molten metal or of spilling molten metals is ever present with these operations, and if molten metals come into contact with flammable material, ignition will result.

Volatile Liquids

Such liquids include paint, varnish, lacquer, sealers, finishing materials, cleaners, solvents, and other petroleum products. They are frequent sources of fires, caused by vapors resulting from the rapid evaporation of the liquids. The liquid itself does not burn, but heat causes vaporation which may be ignited by sparks from nearby heated metals, sparks from metallic objects striking together, electrical spark from light switches, static electricity, or any open flame. Vapors are generally heavier than air and may travel along the floor a considerable distance before they are ignited and flash back to the sources. Tight metal containers, properly color coded, labeled, and kept in metal cabinets, are a requirement for storage. Fire prevention codes specify that no more than five gallons of such liquids may be stored inside the work area. Approved metal safety cans having an anti-flash screen or flame arrester in the spout should be used.

Classification of Fires

Four general classifications of fires based on the types of extinguishing media necessary to combat each have been adopted by the National Fire Protection Association.[17]

Class A Fires

Class A fires are those which occur in ordinary materials, such as wood, paper, excelsior, rags, and rubbish. The quenching and cooling effects of water or of solutions containing large percentages of water are of first importance in extinguishing these fires. Special dry chemical agents (multi-purpose dry chemical) provide rapid knockdown of the flames and the formation of a coating which tends to retard further combustion.

Class B Fires

Class B fires are those which occur in the vapor-air mixture over the surface of flammable liquids such as gasoline, oil, grease, paints, and thinners. The limiting of air (oxygen), or the combustion-inhibiting effect, is of primary importance on fires of this class. Solid streams of water are likely to spread the fire. Under certain circumstances water fog nozzles prove effective. Generally, regular dry chemical, multi-purpose dry chemical, or carbon dioxide foam are used, depending on the circumstances of the fire.

Class C Fires

Fires that occur in or near electrical equipment where non-conducting extinguishing agents must be used are called Class C Fires. Dry chemical, carbon dioxide, or compressed gas extinguishing agents are suitable. Foam or a stream of water are good conductors and can expose the operator to a severe shock hazard and therefore should not be used. Water from a very fine spray can sometimes be used on fires and electrical equipment, as in transformers. A spray is not as good an electrical conductor as a stream of water, therefore safer to use in such cases.

Class D Fires

Fires that occur in combustible metals such as magnesium, titanium, zirconium, lithium, and sodium are classified under Class D. Specialized techniques, extinguishing agents, and extinguishing equipment have been developed to control and extinguish fires of this type. Normal extinguishing agents generally should not be used on metal fires, as there is a danger in most cases of increasing the intensity of the fire due to chemical reactions between extinguishing agents and the burning metal.

Control of Fires

Most schools have an alarm system for signaling students and teachers that the building should be evacuated because of fire, gas, smoke, or impending disaster, and most states require by law that schools hold fire drills at regular intervals. Shop teachers must make certain that they know the fire drill regulations and instruct students in procedures to follow.[18] The general school fire drill signal should be in a location and of a type that can be easily heard by students working in noisy shops. The location of the nearest switch or box used for signaling fires should be known to shop teachers and students in case they need to report shop fires. The location of fire exits should be conspicuously marked and known by all.

In addition to knowing exactly what to do during a general fire drill, shop students need to be told what should be done before they evacuate the building. When the alarm is sounded:

1. Students should stop activity and listen for instructions.

2. Each piece of operating equipment should be turned off and all power disconnected at the main switch.

3. Gas valves, torches, and portable heating equipment should be turned off.

4. Students should leave the area immediately and according to the fire drill plan.

Effective fire control within the school shop involves a system for evacuating the room independent of the rest of the school in cases where the fire originates in a shop area. Perhaps more important in the day-to-day operation of shops are the fire prevention measures and the protection incorporated in the organization of the shop. However, even with the best of facilities fire may occur, and proper fire fighting equipment must be at hand and ready to use. Portable fire extinguishers of the types suitable for controlling Class A, B, or C fires must be prominently and conveniently located about the room. Each type should be located close to an area where the corresponding type fires are apt to occur. The soda acid, or water type is commonly used for Class A Fires. For Class B and C Fires, as well as small Class A Fires, the dry chemical, and carbon dioxide extinguishers may be used. Recently, manufacturers of fire protection equipment have developed an all-purpose extinguisher reported to be effective against all classes of fires. The liquid and the vaporizing type of extinguisher using carbon tetrachloride are no longer recommended because of the generation of extremely toxic fumes when applied to a fire.

Fire estinguishers must be inspected frequently and recharged periodically. The local fire department will usually give advice, assistance, and maintenance, as well as instruction in the use of fire fighting equipment. Students should receive instruction on the care and use of the different types of fire extinguishers. An efficient fire protection plan will include the use of students as fire fighters, since quick control of small fires is essential to the prevention of major fires. If the building is properly planned and equipment is properly installed, if correct materials are used and students are properly taught, the chances of disaster from fire will be greatly diminished.

ELECTRICAL HAZARDS

Almost everyone living in our industrialized society is familiar with the countless uses of electricity as a source of heat and power. In fact, the use of electricity has become so commonplace that few people realize the potential dangers of electrical energy. Many men, women, and children die each year from electrical shock and burns. Most of these tragedies could have been prevented had the necessary precautions been taken to eliminate unsafe electrical conditions and practices. School shop and laboratory teachers must recognize the importance of and need for the identification and elimination of hazards created by electricity.[19]

Failure to understand the danger of electrical energy is a cause of many accidents. Electrical energy is not to be feared, but to be respected. The teacher should understand the relationships between amperage, voltage, and resistance. The use of the terms "low-voltage" and "high-voltage" has led many persons to erroneously believe that low voltage is relatively safe and that there is very little danger of shock from the average home or shop electrical circuit. Such is not the case, since "low voltage" is usually considered by most authorities to be any voltage less than 550 volts. Fatal accidents have been caused by contact with electrical circuits containing less than 50 volts, and deaths have been caused by circuits carrying 1/10 ampere or less. The school shop teacher must assume that any electrical circuit is a potential hazard, regardless of the amount of voltage or amperage flowing through the wires to the equipment.

Results of Electrical Accidents

Numerous factors affect the results of electrical accidents. Bodily contact with the hazards of electricity may result in producing: 1) nerve shock, 2) severe burns, 3) fire damage. and 4) physical injuries. The severity of injuries from electricity depends upon a wide variety of factors.

Shock occurs when an electrical current flows through any part of the body. Electricity is a "live" force which is always seeking a path to the ground in order to complete the circuit. When the human body becomes a part of the circuit, there may be electrical shock. The severity of the shock may be very slight, ranging from a mere tingling sensation, to a very severe shock causing muscle contraction of certain vital organs in the body. The severity of the shock will depend upon 1) the rate of flow of current through the body measured in amperes, 2) the path of the current through the body, and 3) the length of time the body is in the circuit. Other factors which may affect the degree of shock are the frequency of the current, phase of the heart cycle when shock occurs, and the physical and psychological condition of the person.

The amount of current which flows through the body will depend upon skin and clothing resistance, the insulting qualities of the surrounding area, the amount of voltage in the circuit, and the manner of contact with the live circuit. Dry human skin does offer some resistance to the flow of electricity, although this resistance varies with other special conditions. It has been estimated that dry skin offers from 100,000 to 600,000 ohms of resistance, while wet and sweaty skin will offer a resistance of only 1,000 ohms or less to the flow of electricity. Assuming the body offers only 1,000 ohms of resistance, the 110 volts would push sufficient amperage through the body to result in a serious injury or fatality.

The path the current takes as it flows through the body will depend upon the nature of the contact with the energized circuit. If the head area is in contact with electric current and the feet are grounded, the current will very likely pass through the brain, lungs, and heart, causing muscular spasms resulting in death. However if one foot touches a live wire while the other foot is on the ground, the current in not likely to pass through one of the vital organs of the body and the injury will probably be less severe.

The length of time a victim of electric shock is in contact with an energized circuit is very evant to the degree of injury. Sometimes a victim is knocked away from the circuit immediately after touching the charged object and little or no damage occurs, whereas a longer contact with a live circuit may cause ome of the organs of the body to stop functioning.

The nature of the injury may be affected by the frequency of the current and the kind of electrical energy. Direct current is usually considered less hazardous than alternating current as far as shock is concerned, but is more likely to produce severe burns and tissue damage. The physical condition of the victim is another factor which has a bearing on the severity of electrical shock.

Electric shock affects the human body in various ways, depending upon the presence of the various factors mentioned above. It may cause a temporary paralysis of the nerves which control breathing and cause the breathing to stop. It may cause the chest muscles to contract and result in asphyxiation, or it may cause the heart muscles to contract and interfere with the normal rhythm of the heart, thus stopping circulation of the blood. In addition to nerve shock, severe burns may result from contact with an energized circuit, especially a high voltage direct current. Contact with a live circuit may destroy the tissue and nerves of the body. Wounds caused by arcing electrical current are usually severe and slow healing.

Other accidents, injuries, and property loss may result from fires caused by unsafe electrical conditions or practices. In fact, most injuries caused by electrical hazards are secondary effects, such as falls due to shock, accidental starting of motors, circuit breaker handles hitting various parts of the body, etc. Numerous fires resulting in injury are caused by poor electrical maintenance, unsafe installation procedures, improper use of equipment, or overloading of circuits.

Causes of Electrical Accidents

Electrical accidents are caused by unsafe conditions, unsafe practices, or a combination of both. Statistics tabulated by state labor departments reveal that several hundred industrial workers are killed and possibly 5,000 persons injured each year by accidental contact with electricity. A study in the State of California by The Division of Labor Statistics and Research reveals that "unsafe practices were reported in four out of five accidents. Using unsafe or defective tools or equipment led the list, while failure to de-energize equipment, using tools or equipment in an unsafe manner, and working in hazardous places, were next in that order." Causes of electrical accidents can in most cases be traced to 1) defective equipment, 2) unsafe work practices, and 3) lack of knowledge of the dangers of electricity.

Defective Equipment

Types of equipment involved in electrical accidents, include motor-driven equipment, control devices, portable electric tools, switches, panels, cutouts, conductors, plugs and fuses, and electric extension cords. A variety of unsafe conditions involving the different types of equipment creates many electrical hazards. Some of the common defects of tools and equipment are listed as follows:

1. Improperly grounded equipment (ground wires missing, broken, or improperly connected).

2. Open conduits, switch boxes, damaged or worn connections, and exposed live wires.

3. Insulation which is defective, inadequate, worn, frayed, wet, oily or deteriorated creating short circuit possibilities, and energizing equipment frames.

4. Defective switches, receptacles, extension cords, and lamp sockets.

5. Dirty motor windings, improperly adjusted brushes, and inadequate maintenance procedures and upkeep of electrical equipment and accessories.

6. Improperly connected power tools and defective insulation in portable tools.

7. Loose vibrating machine parts which might create short circuits and energized machine frames.

Unsafe Practices

Unsafe practices and work procedures result in electrical accidents and fires. Some of the common unsafe acts committed in the shop are:

1. Using ungrounded equipment and portable tools or removing ground connections.

2. Using defective tools or equipment in need of repair.

3. Using equipment which does not meet the approval of the Underwriters' Laboratories or other similar agencies.

4. Unsafe cleaning of electrical panels, switch boxes, motors, and other electrical equipment with water or dangerous solvents.

5. Overloading of circuits or overfusing circuits by the use of wrong size or type of fuse.

6. Failure to use explosion-proof or vapor-proof fixtures in dangerous areas.

7. Failure to use suitable safety equipment, gloves, rubber mats, etc., for electrical installation and repair.

8. Failure to de-energize circuits before working on equipment.

9. Failure to mark, tag, or identify and lock switches properly prior to working on electrical equipment.

10. Installation of electrical facilities not meeting the National Electrical Code.

11. Improper opening and closing of switches and improper use of electrical equipment.

12. Permitting rubbish, trash, rags, etc., to accumulate near electrical equipment.

13. Work practices which damage motors, insulation, wires, or electrical accessories.

14. Disconnecting of electric cords by pulling on the cords rather than on the plug; stringing extension cords around the shop.

15. Use of metal ladders while working on electrical equipment.

Although the above list of unsafe practices is far from complete, the shop teacher should be aware of the common electrical hazards and unsafe practices and be able to identify and eliminate them.

Lack of Knowledge

Ignorance is no excuse as the cause of electrical accidents. It is unfortunate that a number of electrical accidents do happen because the person "just didn't know any better." Too many people lack an understanding of electricity which could be remedied through adequate supervision and a sound educational program.

Prevention and Elimination of Electrical Hazards

Electrical hazards may be controlled by a program directed toward 1) preventing the development of hazards, and 2) eliminating present hazards. In both cases a positive program of action must include education and training. Students should be taught the basic concepts necessary to understand electrical energy. Safe practices should be taught and the reasons for following definite procedures explained to the students. Teachers should analyze the shop environment and list all possible sources of electrical hazards. Each item on the list should be discussed with students and the safe practices which attend each hazard should be taught to all concerned. When students fully understand the causes and results of electrical accidents, they will want to assist the instructor in identifying present hazards and potentially dangerous situations.

Identification of existing and potential electrical hazards requires frequent and systematic inspection of all equipment. Each teacher should develop a check list of items pertinent to his area of responsibility. Student inspection can be a part of the regular duties of the "safety engineer" and, through a personnel system, students can be taught to make visual inspections. A most important corollary in an inspection program is the development of student awareness of electrical safety. Visual inspection of motors, generators, panels, transformers, controls, switches, lights, outlets, conduits, and cords should be made on a scheduled basis. Attention should be directed toward 1) damaged or broken materials–insulation, wire, receptacles, plugs, switches, etc., 2) accumulation of oil, water, dust, or other extraneous matter near equipment, 3) malfunctioning equipment, and 4) warning signs and markings. In addition to visual inspections, circuits and equipment should be ground-tested, using a suitable type of tester such as a low-range ohmmeter, to determine the condition of circuit grounds. Equipment and circuits should also be checked with a megohmeter to determine if current leakage may have developed due to insulation deterioration. If periodic readings are made and recorded, it is possible to anticipate the replacement of wiring or insulation. Likewise, a record of visual inspections presents a picture of the condition of electrical equipment in the shop to the teachers. Once identified, electrical hazards can be readily eliminated. This may involve such actions as rewiring, adding insulation, isolating certain equipment, grounding equipment, replacing parts, or simply cleaning equipment.

Preventive maintenance practices and regularly scheduled maintenance of electrical equipment must be included in any safety program. Accumulation of dust, grease, or a combination of the two in electrical panels, motors, and generators will eventually lead to electrical troubles and may result in short circuits which can harm students or cause fires. The continued use of worn or improperly lubricated equipment can also cause insulation breakdown. Manufacturer's recommendations for lubricating and cleaning electrical equipment should be followed at all times.

Some electrical hazards can be prevented at the time equipment is purchased. Only equipment meeting the Underwriters' approval should be considered for use in school shops. There are differences among items of equipment in regard to the degree of control of electrical hazards. The wise shop teacher will select the equipment which offers the most protection to the user. Such things as polarized plugs, heavy insulation, lock-out switches, and safety switches should be considered.

Even though the safest equipment available is purchased, the value of careful selection is lost if equipment is improperly installed. All wiring and installation should be done by qualified electricians who will perform the work in accordance with the local and state requirements, as well as meeting the specifications of the National Electrical Code. Haphazard electrical work and so-called temporary hook-ups must not be permitted in the school shop. All original and subsequent electrical installations should be made so that:

1. All equipment is properly grounded.

2. Wiring is of adequate size to carry the intended load.

3. Each item of equipment is individually protected with fuses or circuit breakers.

4. Wiring is protected from damage.

5. Sub-master switches are installed.

6. Magnetic starting switches are incorporated on each piece of equipment to prevent inadvertent restarting.

In shops where two or more voltages are used for different kinds of portable equipment, special receptacles are needed for each voltage. Receptacles and the corresponding cord plugs must be designed to eliminate all possibility of connecting the equipment to the wrong source of power. Cord plugs should not be adapted in the school shop, and the use of adapters should be strictly forbidden.

In summary, an adequate program for the prevention and elimination of electrical hazards must rest upon 1) intelligent selection and purchase of equipment, 2) correct installation of equipment, 3) education of students in the safe use of electrical energy, 4) periodic inspection of equipment, and 5) regular maintenance.

HOUSEKEEPING

Most safety specialists and competent vocational teachers consider housekeeping to be one of the most important activities in creating an environment relatively free from accident-producing hazards. The term "housekeeping" is often misunderstood and misrepresented by some to mean a "push broom" activity in the school shop and laboratory area. Housekeeping means more than keeping the facilities clean and free of undesirable scraps, shavings, and dirt. It also means orderliness. Housekeeping includes an orderly arrangement of tools, equipment, operations, storage facilities, and materials. The shop is in order when there are no unnecessary materials, tools, and scraps scattered about the area, and necessary tools and materials are in their proper places. The often quoted phrase "a place for everything and everything in its place" is most appropriate in a discussion of housekeeping in school shops and laboratories.[20]

Objectives of Housekeeping

Housekeeping in an accident prevention program has many objectives. Everyone working in the shop or laboratory has a personal responsibility to help the teacher realize the goals of maintaining a clean and orderly work area. Specifically, a few of the goals of effective housekeeping programs are:

1. To reduce or eliminate hazards which cause accidents from falls, slips, striking against objects, and falling objects.

2. To eliminate the hazards from fire through the provision of approved containers, proper storage facilities, and clean-up procedures.

3. To develop and awareness of the need for housekeeping measures in an accident prevention program.

4. To develop the desired attitudes towards safe working conditions and practices and sanitary conditions.

5. To develop an understanding of the essentials of an effective housekeeping program.

6. To familiarize students with the responsibilities of housekeeping and to instill in them the desire for clean and orderly surroundings.

Responsibilities for Housekeeping

The planning and maintaining of an effective housekeeping program in school shops and laboratories are the combined responsibilities of the administration, the teachers, and the students. In fact, everyone working in these areas must assume some of the responsibility for keeping the facility clean and orderly. Administrators must recognize that good housekeeping procedures are very important in an accident prevention program, and the administration must take the lead in formulating general policies and plans for shop housekeeping. The administration has the specific responsibility to provide adequate space and funds, because effective housekeeping practices are most difficult in a crowded, poorly arranged, and improperly planned shop or laboratory. The teacher has the immediate responsibility for the program, since housekeeping is largely a matter of management and organization. Good housekeeping will depend upon the provision of:

1. Adequate storage rooms, areas, shelves, racks, and cabinets for materials and supplies, projects, tools, equipment, and accessories.

2. Suitable containers for scraps, shavings, chips, and other waste material.

3. Splash guards and oil pans on all machines using oil and coolant.

4. Adequate dust collecting systems.

5. Proper housekeeping instruction and training.

6. Proper layout of equipment, traffic areas, aisles, and working areas.

7. Adequate housekeeping and janitorial facilities for cleaning windows, ledges, shelves, etc.

Good Housekeeping Practices

Good housekeeping cannot be attained by an occasional grand clean-up. If the shop or laboratory is to be kept clean and orderly, the program must be planned and organized. Teachers should adopt a policy of locating and correcting conditions that produce congestion, disorder, dirt, waste, trash, and other poor housekeeping conditions. The program for keeping the area clean must be one of continuous activity, and procedures must be established for checking and evaluating its effectiveness. Various inspection lists have been developed to check on housekeeping practices, or teachers may want to develop their own inspection check lists adapted to the needs of their particular shop. The National Safety Council inspection list discussed in this guide provides a reminder of things to look for when checking on clean and orderly conditions. The following are examples of good housekeeping practices:

1. The general appearance of the area is clean, orderly, and well painted, with adequate lighting and ventilating facilities.
2. The machinery and equipment are arranged to permit safe, efficient work practices and ease in cleaning.
3. Materials and supplies are safely stacked or stored in proper places.
4. Tools and accessories are safely stored in cabinets, on racks, or other suitable devices.
5. Sufficient waste containers and receptacles are provided in appropriate locations and emptied frequently.
6. The working areas and work benches are clear and free of debris and other hazards.
7. Floors are clean and free from all obstructions, foreign material, or slippery substances such as water, oil, and grease. Floor surfaces are slip-resistant.
8. Aisles, traffic areas, and exits are free of materials and other debris. They are properly marked and defined.
9. All corners are clean, well lighted, and free from waste materials.
10. Combustible materials are properly disposed or stored in approved containers.
11. Clean rags and waste are stored in metal containers, while oily rags are stored in self-closing or spring-lid metal containers.
12. All flammable liquids are stored in safety cans and the safety cans are stored in fireproof rooms or cabinets.
13. Dangerous materials are stored in areas outside of the main building.
14. All boxes, bins, shelves, cabinets, or containers used to store materials are properly marked or labeled.
15. Excess materials are not allowed to remain in the work areas.

16. Floors, walls, ceilings, ducts, electric lights, and windows are cleaned frequently and regularly.

17. Obsolete equipment is removed from the shop area and disposed of.

18. Sufficient brooms, brushes, cleaners, and other housekeeping equipment are readily available.

19. Pupil personnel organization systems are used to carry out specific housekeeping duties.

20. Personnel working in the area are instructed on the proper procedures to follow in keeping the area clean and orderly.

21. Regular and systematic inspections are made to maintain clean and orderly conditions.

HEALTH HAZARDS

The variety of substances and processes presenting hazards to the health of students in school shops and laboratories steadily increases. Safeguarding the present and future health of these students is the prime responsibility of school administrators, supervisors, and teachers. The purpose of this section of the guide is to acquaint the school personnel with potential occupational health hazards, types of exposure, and measures commonly used to control these hazards. This information in turn should be transmitted to the students—the future workers and supervisors of our industries.

Classification of Hazards

Occupational health hazards which may adversely affect a worker or a shop or laboratory student are usually classified as a) chemical agents, b) biological agents, and c) physical agents.

Chemical Agents

Chemical agents in industry and school shops are liquids, solids, and gases which may produce injury by ingestion, contact, or inhalation. The chemical agents of particular concern are those which are flammable, toxic, corrosive (to living tissue), irritating, strongly sensitizing, radioactive, or which generate pressure through heat, decomposition, or other means. These agents may also be dispersed in the air as dusts, fumes, mists, vapors, and gases.

Dusts are solid particles which may be generated by the grinding, drilling, sawing, filing, turning, sanding, shaping, detonation, pounding, or crushing of materials such as rock, metal, wood, ore, coal, grain, glass, and plastics. Dusts can be dispersed in the air but will eventually settle. Thus they do not diffuse in the air. The most hazardous dusts which can be found in school shops are lead and quartz. Lead dusts may result from the sawing of lead type slugs or from the remelter in the printing shop. Lead dusts may also be found in ceramics shops where glazes containing lead oxide are processed. Quartz dusts are present in molding sands and some parting compounds used in the foundry shop. In vocational agriculture shops, organic phosphates can be found in some pesticides used in the instructional process. In some cases wood dusts can be very toxic to sensitive students.

Fumes are solid particles in the air generated by condensation from the gaseous state, generally after volatilization from molten metals. Fumes found in school shops include lead fumes in printing shops generated by type composing machines and from remelt lead pots and from ceramic kilns where lead oxide glazes are fired. Cadmium, lead, zinc, and other metallic fumes can be generated during the welding, brazing, cutting, or soldering of metals.

Mists are liquid droplets suspended in the air and generated by condensation or by splashing, foaming, or atomizing. Acid mists are present in electrical or auto mechanics shops where storage batteries are charged. Oil mists are present in machine shops where machine tool lubricants or coolants are used.

Vapors are liquids or solids in a gaseous state. Vapors diffuse in the air. The major source of health hazards from vapors are the toxic solvents commonly found in most school shops and laboratories. Among these are trichloroethylene and perchloroethlene (used as degreasers and as solvents in some types of plastic cements or dopes); carbon tetrachloride (solvent for fats and waxes, rubber solvent type cleaner); methyl chloroform (solvent for oils, fats, waxes, resins, and rubbers); turpentine (solvent for oil paints); and acetates, ketones, and alcohols generally used as lacquer thinner. Inhalation of solvent vapors can cause serious damage to the kidneys, liver, and other vital organs. Repeated inhalation of the vapor of trichloroethylene, for example, can cause serious injury to the nervous system, the lungs, the skin, and the digestive tract. The vapors of carbon tetrachloride are readily absorbed by the mucous membranes and the lungs; and in chronic exposure, damage to the liver, heart, and kidneys may result. The vapors of turpentine may act as a strong irritant and systemic poison and, when absorbed through the lungs, may cause kidney damage.

Gases are normally elastic fluids which occupy the space of enclosure and which can be changed to a solid or liquid state through the combination of increased pressure and decreased temperature. Gases will diffuse in the air. The most common of the hazardous gases to be found in school shops are carbon monoxide and oxides of nitrogen and ozone. Carbon monoxide may be found in auto mechanics shops, in metal shops, and in industrial arts ceramics areas. Carbon monoxide has no warning properties and may reach a hazardous concentration before students are aware of its presence. Oxides of nitrogen are produced by the action of ultra-violet radiation on the nitrogen of air, as in inert gas shield and arc welding. The shield of argon gas around the arc increases the production of ozone, and the use of a consumable electrode increases it still more. Ozone is a lung-injuring gas and may be lethal with sufficient exposure. The addition of nitrogen oxide to the ozone will increase the toxicity of the ozone.

Biological Agents

Health hazards associated with occupational exposure to biological agents have not received the same attention in this country as have chemical and physical agents.[21] This is perhaps due to the fact that illness caused by them is symptomatically similar to and usually attributed to non-occupational causes. Neverthless, certain bacteria, fungi, and parasites of occupational origin are known to cause illness, extreme discomfort, and even death in some instances. Bacterial infections, for example, may arise in employees of slaughter and meat-packing plants from handling cattle infected with Bang's diseases, and anthrax may develop in employees handling unsterilized wool and hair bristles imported from certain foreign countries. Athlete's foot is a common fungus infection. Though painful and uncomfortable, it is usually not disabling and rarely occupational. On the other hand, histoplasmosis, a condition caused by a fungus which has been isolated from chicken manure and the soil around poultry houses, may cause a serious and prolonged illness. Parasites such as mites cause grain and cheese itch. And whild parasites are seldom disabling, they can cause extreme discomfort.

Physical Agents

Exposures to environmental conditions or physical agents are just as important and encompass as large a field from the standpoint of occupational health as do the chemical agents. Physical agents and conditions usually include the following: a) electromagnetic and ionizing radiation; b) noise; c) extremes of temperature and humidity; d) abnormal air pressure; and e) repeated motion, shock, or vibration. Exposure to these conditions are significant in industrial operations and are, therefore, areas of concern to shop and laboratory educators.

Electromagnetic radiation encompasses a wide range of absorbable energy and is perhaps the most important of the physical agents. The portion of the electromagnetic spectrum of physiological concern extends from microwaves to cosmic rays. Of increasing importance to occupational health and safety personnel is the control of ionizing radiation from sources of electromagnetic energy or radioactive particles. Some of these, X-rays, alpha, beta, and gamma radiation, for example, can be extremely dangerous, even in exposures of short duration. Other, such as ultra-violet, can cause irritating to severe burns following moderate exposures, while others like radio waves cause no apparent injury to the body even after a lifetime of exposure. In addition to radio isotopes, the chief sources of ionizing radiation are various types of electronic equipment found in electrical and electronics shops. Exposure to ultra-violet radiation can result from such sources as the arc welding process, ultra-violet lamps used for inspecting flaws in metal casting, or carbon arcs used in the printing shop for etching plates. Injury from infrared radiation can result from prolonged exposure to molten metals, heat from heat treating ovens, pottery kilns, and infrared lamps. Radiant heat passes through the air without heating it, and its effect is not apparent until it strikes an object such as the human body. As technical education expands and provides more shop and laboratory experiences for students, the greater will become the hazards from such devices as radar, microwave generators, and diathermy equipment. Exposure to microwaves can cause serious tissue injury. The extent of the hazard, however, depends upon the wave length, the power density, and the duration of exposure.

Noise in the school shop is not as serious as the other health hazards previously discussed. Increasing attention, however, is being given to occupational exposure to high levels of noise. Noise is generally defined as unwanted sound and chronic exposure at certain levels can cause temporary or permanent loss of hearing, nervousness, and fatigue. The degree of injury depends upon intensity, frequency, duration of exposure, and the susceptibility of the individual.

Extremes of temperature and humidity as environmental conditions should not pose a health problem in school shops and laboratories. Students should be aware, however, that conditions do prevail in certain industrial operations which result in more complaints among workers than all of the other physical agents and conditions combined. A reduction in the quality and quantity of work output, increased fatigue, and a host of other personal complaints may result from extremes of temperature and humidity. If extremes of low temperature are involved, such as subzero food storage lockers and experimental test chambers, workers may develop frostbite. From a practical viewpoint, however, sudden and abrupt changes in temperature and humidity are more important because of the more adverse physiological effects upon workers. There is evidence that exposure to cold and changes in temperature may lower resistance to infection. A number of factors determine the reaction of an individual to adverse temperature and humidity conditions. Among these are a) air temperature, b) relative humidity, c) radiant heat, d) air motion, e) degree of exertion, f) type of clothing, and g) acclimatization.

Abnormal air pressure as an environmental condition should not pose a health problem in school shops and laboratories, but again this potential hazard should be brought to the attention of students. Caisson disease is an illness, occurring among divers, caisson workers, and submarine tunnel workers, caused by the too rapid removal from pressure resulting in the liberation of nitrogen gas bubbles in body tissues and fluids. The gas formed in the tissues blocks the capillaries and cuts off the blood supply to and from various parts of the body. The symptoms, known as the "bends," are pains in the muscles and joints, tingling of the skin, and dizziness, and, in severe cases, asphyxia may occur.

Repeated motion, vibration, or shock as a category of physical agents is receiving increased attention in the field of occupational health hazards, although this may not be of concern at present in school shops and laboratories. It is believed, however, that vibrating tools and machinery may induce nervousness and fatigue in some individuals, while long and continued use of vibratory tools may cause nerve injury and inflammation of tissue surrounding tendons, bones, and joints. Rock drillers and high-speed grinder operators sometimes experience soft tissue, tendon, bone, muscular, and nerve disorders.

Types of Exposures

Chemical and biological agents enter the body by inhalation, through the skin, or by ingestion. Inhalation and skin contact are important because the majority of occupational diseases results from breathing dusts, fumes, vapors, gases and mists, and from skin contact with chemical or biological materials.[22]

Inhalation

Frequently, toxic materials are quickly aborbed into the blood or, when inhaled, into the fluids in the lungs. Carbon monoxide, for example, combines with the red blood cells 300 times more readily than does oxygen. An individual inhaling one ounce of alcohol as vapor would feel the effects much faster than if he had drunk the same quantity. Most solvent vapors and gases when inhaled in sufficient amounts produce their injurious effects on the human system in a relatively short time. Some dusts and fumes may be partly or wholly dissolved by the fluids in the lungs and then absorbed by the system. Fumes cause injury by irritation of the air passages as well as of lung tissue. Some dusts set up an inflammatory process leading to changes in lung tissue which eventually affect the vital capacity of the lungs.[22]

Skin Contact

Occupational skin diseases account for about 65 per cent of occupational diseases reported. The increasing use of epoxy resins, for example, cause numerous outbreaks of dermatosis, due primarily to the amine hardeners or catalysts. Chrome ulcers of the skin and contact dermatitis can be caused by chromic acid and its salts. Individual susceptibility to skin disease vary; some persons have a low tolerance while others may develop a high tolerance to these materials. Solvents such as trichloroethylene and mineral spirits dissolve the protective surface lipids from the skin, facilitate the loss of water, and result in dry, chapped or cracked skin. Fissuring and cracking of the skin make it readily susceptible to secondary infection. Corrosive chemicals such as strong acids and alkalis and certain of their salts attack the skin directly. Contact with high concentration of these chemicals can cause burns, resulting in the destruction of tissue and permanent scars or disfigurement. A few toxic substances such as aniline, tetraethyl lead, and carbon disulfide can be absorbed through the skin and cause systemic poisoning. Chronic effects can also occur from continued absorption of some substances through the skin.[22] [Absorption of hazardous substances may also occur through the mucous membranes of the lips, mouth, nose, and eyes.]

Ingestion

Chronic poisoning can occur if small amounts of toxic substances are swallowed daily. When dealing with toxic substances such as lead, arsenic, mercury, and the new insecticides, every precaution must be taken to prevent their entry into the digestive tract. Frequent washing of the hands, especially before eating or smoking, will reduce this hazard considerably.[22]

Control of the Environment

Control of exposure to health hazards in the school shop and laboratory situation may be accomplished through one or more of the following methods:

1. **A change of process.** For example, paint may be applied with a brush instead of a spray gun.

2. **Substitution of less toxic materials.** For example, a less toxic solvent may be used as a substitute for carbon tetrachloride.

3. **Control at the point of generation.** Localized exhaust ducts, for example, could be used during the arc welding process.

4. **Enclose the operation.** A screen or shield, for example, could be placed around an arc welding job or permanent cubicles provided for student use in welding operation.

5. **Dilution with uncontaminated air.** This is especially applicable where the exposure is to solvent vapors.

6. **Personal protective devices.** An example would be the use of approved helmets, gloves, and clothing during arc welding activity.

7. **Maintenance, housekeeping, and education.** An example of maintenance is the cleaning of the blades of an exhaust fan in a paint spray booth. The use of vacuum cleaners or vacuum lines in the shop is a good example of housekeeping. Education of the workers and students is important if they are to use effectively the control measures provided for their health and safety.

PERSONAL PROTECTIVE EQUIPMENT

The safety-minded shop or laboratory teacher will recognize the need for eliminating hazards at all possible points of occurrence, and he must, therefore, be an expert in his own right. The teacher must be alert to dangers of handling materials, hand tools, power equipment, and processes and practices carried on in the shop. He must recognize unsafe machinery and equipment which may have been inadvisably placed in the school shop. The alert teacher will either eliminate such items or take steps to guard the devices properly before they are used by students. Only after this has been accomplished to the teacher's complete satisfaction, should he turn to the need for personal protective equipment. In other words, a machine so designed that it effectively prevents the possibility of flying particles and other such hazards eliminates a cause of accidents at the source. This is a more basic treatment of the problem than the use of personal protective equipment. Safety goggles, for example, are protective devices, but they do nothing to eliminate or reduce the hazard at its source. Personal protective equipment should never be considered the first line of defense in hazard elimination. Equipment of this nature is only "backup" protection for the unexpected or the unusual.

Personal protective equipment can conveniently be classified as follows:

1. Eye and face protection:

    a. Safety goggles.

    b. Safety glasses.

    c. Helmets and hand shields.

    d. Face shields.

2. Head and ear protection:

    a. Safety hats.

    b. Hair protection.

    c. Ear protection.

3. Hand, foot, and leg protection:

    a. Gloves and hand leathers.

   b. Foot protection.

   c. Leg protection.

4. Respiratory equipment:

   a. Filter respirators.

   b. Other respiratory protective devices.

5. Protective clothing:

   a. Shop coats.

   b. Aprons.

   c. Coveralls and overalls.

Eye and Face Protection

One of the best starting points for establishing the habit of using personal safety equipment is the use of eye protection. Instructors and students alike are well aware of the value of sight and full vision, and proper eye care is emphasized even in childhood. Vivid memories of the pain resulting from the entry of minute foreign particles further reinforce the value of eye care. Shop and laboratory teachers should establish a one hundred per cent eye protection program. meaning that every person, including the teacher and visitors, must wear the required eye protective equipment at all times while in the shop of laboratory, rather than on an individual job basis. An increasing number of state legislatures have passed state laws which require one hundred per cent eye protection in school shops and laboratories. The National Society for the Prevention of Blindness, Inc. (16 East Fortieth Street, New York, New York, 10016) has made available to state school administrators a model school eye safety law. Section I of such a sample bill will be found in Appendix F of this guide. Further information can be obtained by writing directly to the National Society. An excellent series of articles on eye protection has been published by the National Safety Council in their *National Safety News* and reprinted in the *Fundamentals of Industrial Hygiene.*[32]

Each eye, face, or face and eye protector is designed for a particular hazard. Only protective eye wear of industrial quality as specified by the United States of America Standards Institute, or equal, should be used. The USASI quality standards cover such important features of protective eye wear as lens thickness, lens penetration, lens retention, optical quality, flame resistance of the frame, sterilizability, warp resistance, and the like. In selecting the protector, consideration should be given to the kind and degree of hazard, and the protector should be selected on that basis. Where there is a choice of protectors, the degree of protection required should govern the selection. Where the degree of protection required is not an important issue, student comfort may be a deciding factor.

A brief description of various types of eye and face protectors, along with suggestions for their use and an understanding of their limitations, follows:

Cover goggles

Cover goggles consist of a pair of contour-shaped eyecups or facial contact parts with glass or plastic lenses worn over the eyes and held in place by a headband for the protection of the eyes and the eye sockets. The term "goggles" is also loosely but incorrectly applied to spectacle-type protectors. There are several types of goggles:

1. **Eyecup goggles.** Each eyecup is provided with a lens retainer bearing evenly on the lens with sufficient pressure to retain fragments in the event of lens breakage. The design permits the ready removal or replacement of lenses. Lens retainers for welders and cutters are made to accommodate a filter lens, fiber gasket, and cover lens.

2. **Flexible-fitting goggles.** Flexible-fitting safety goggles protect against fine dust, fumes, liquids, splashes, mists, and sprays. The frame is composed of a flexible, chemical-resistent, non-toxic, non-irritating, slow-burning material forming a lens holder. The flexible-fitting goggles are usually ventilated to prevent fogging. In some cases, the ventilation is so designed as to make the goggles splash-proof. Since the frame is of non-rigid material, they offer less pretection against impact than do eyecup goggles.

3. **Plastic eyeshield goggles.** Plastic eyeshield goggles provide protection against light flying objects and, when so designed, against glare and injurious radiation. They are acceptable for light chipping or grinding operations, for use around woodworking machines, for spot welding, for babbitting, and for protection against glare or low concentration of injurious radiation. They should not be used for protection against severe flying object hazards or for welding.

4. **Foundrymen's goggles.** Foundrymen's goggles consist of a mask made of flexible, non-irritating, and non-combustible or slow-burning material, metal lens holders, lenses, and a positive means of support on the face. The edge of the mask in contact with the face is provided with a binding of corduroy or other suitable material. These goggles are used to provide protection against impact and hot metal splash hazards encountered in foundry operations, such as melting, pouring, chipping, babbitting, grinding, and riveting. They are also designed to provide protection against dust.

Protective spectacles

Safety spectacles are devices patterned after the conventional type street wear spectacles but are of more substantial construction, either with or without side shields, and with impact-resistant lenses. Clip-on side shields are also available for easy conversion of spectacles for frontal protection to protection from the side. Lenses may be clear or filter type, glass or plastic. Corrective safety lenses may also be mounted in safety frames, provided the lenses are tempered to meet the proper impact standards. Two types of spectacles are described below:

1. **Metal, plastic, or combination frame spectacles** are intended to provide protection from flying objects and glare and injurious radiation. Spectacles without side shields provide frontal eye protection only. Where side as well as frontal eye protection is necessary, the spectacles should be provided with side shields made of metal or slow-burning plastic materials. Spectacles are used for light chipping operations, for grinding, for machine tool operations, and for other jobs involving flying object hazards. When provided with filter lenses, they may be used for furnace operations, molten metal handling, spot welding, and work adjacent to welding.

2. **Plastic eyeshield spectacles.** Plastic eyeshield spectacles are designed to provide protection to the eye from flying objects and glare and injurious radiation. Spectacles without side shields provide frontal eye protection only. Where side as well as frontal protection is required, spectacles are provided with side shields. Plastic eyeshield spectacles are used under the same conditions as plastic or metal frame spectacles, although they are not as durable as the latter.

Students who require vision correction should be encouraged to obtain prescription safety glasses. When students wear prescription spectacles which do not have safety lenses in safety frames, an appropriate cover goggle should be worn over the regular street wear as a protection against shattering of the unhardened lenses. Because of their added cost, prescription safety glasses should be protected against pitting during grinding operations by the wearing of a face shield, cover goggles, or lightweight, sacrificial plastic clip-ons.

Most cover goggle frames are molded in either a flexible or rigid vinyl or soft rubber material. Headbands consist of an elastic adjustable strap which is replaceable at a very nominal cost.

Welding helmets and hand shields

Welding helmets and hand shields are designed to provide protection against intense radiant energy not only for the eyes, but also for the face, ears, and neck. Typical operations which require helmets or hand shields include various kinds of arc welding and heavy gas cutting. Three types are described below:

1. **Helmets.** Because of the area to be protected, the helmet body is of such size and shape as to protect the face, top of the head, and the neck to a vertical line back of the ears. It has an opening or openings in the front for a filter plate and cover plate. The helmet body is supported by a head gear so that it does not come in contact with any part of the head and can be lifted up from in front of the face to allow the welder to examine the weld. The helmet body is made of vulcanized fiber, reinforced plastic, or other suitable heat- and flame-resistant material, opaque to visible ultra-violet and infra-red radiations and able to be disinfected. Rivets or other metal parts, if terminating on the inside surface, are insulated.

2. **Hand shields.** Hand shields are used in some welding operations or for observing the welding process. A handle made of non-conducting, non-combustible, or slow-burning material is used instead of a head gear. The materials used for hand shields are similar to those used for helmets. The lens-mounting arrangement and filter and cover plates are the same as for the helmet.

3. **Nonrigid helmets.** Helmets made of nonrigid materials are designed for use in confined spaces and are collapsible for convenience in carrying. The helmets are of the same general shape of the rigid helmet, except that a more complete covering of the top of the head is necessary to maintain the face, side, and windows in proper position. The requirements for the filter plates, cover plates, and lens-mounting frame are the same as for the rigid helmet.

Face Shields

Face shields are designed to provide protection to the face from flying particles and sprays of hazardous liquids and, in addition, to provide anti-glare protection when needed. Plastics, used in the manufacture of face shields, combine a high degree of mechanical strength with lightness of weight, are non-irritating to the skin when exposed to perspiration, and are capable of withstanding frequent disinfection. Plastic materials should be slow burning. Clear or colored plastic materials used in windows should be of an optical grade to provide equivalent performance with the optical, physical, and radiant energy requirements specified for other eye protectors. When face shields are to be used in atmospheres or working areas requiring special conditions of nonconductivity or non-sparking, all materials used should be made to meet these requirements and plainly and permanently labeled as "non-conductive face shield" or "non-sparking face shield." Some typical uses for face shields include the following: woodworking operations where chips and particles fly; metal machining causing flying particles; buffing, polishing, wire brushing, and grinding operations where flying particles or objects may strike the face; spot welding; and handling of hot or corrosive materials. They are not acceptable for protection against heavy flying objects, for welding, cutting, or intense radiant energy; in such cases, where facial protection is needed, the face shield should be worn over appropriate cover goggles.

Care and Disinfection of Eye Protection

Good eye protective devices require clean lenses. Dirty lenses will blur vision and will eventually cause eye strain. Lenses should be cleaned daily with a solution of warm water and soap (or a cleaning solution) and wiped dry. Pitted or scratched lenses can also reduce vision and should be replaced with new lenses whenever possible. The molded-type plastic frames of protective covers lend themselves readily to lens replacement. Replacing frames requires professional skill, and consideration should be given to replacing the entire unit. Keeping eye protective devices in their cases when not in use will extend their usable life span. The plastic bag or box in which they come provides an ideal dust-proof container for protection.

If a protective device is worn by more than one person, it will require a means of disinfection. The most effective method of disinfecting eye protective equipment is 1) thorough cleansing with soap and warm water; and 2) careful drying with tissue. A complete immersion in disinfecting solution for ten minutes is another way of disinfection. After such treatment the protective devices should be allowed to dry in room temperature, because wiping will destroy the germicidal residue which otherwise retains its effectiveness while in use. Disinfection under ultra-violet light is not recommended since this causes rapid deterioration of plastic and rubber parts.

Head and Ear Protection

Head and/or ear injuries are not common in the school shop or laboratory. However, there are certain school shop activities which warrant use of safety hats or ear protectors. For example, if the school offers a building trades curriculum, it would be advisable to equip students with one of the many new types of safety hats. A class in aeronautics, where there are activities in motor testing, will need both safety hats and ear protectors. Safety or "hard" hats are usually made of glass fiber, plastic, or aluminum. They are lightweight, comfortable, durable, and designed to resist severe impact, penetration, and shock according to federal and other standards for safety hats.

The ease with which a strand of hair can be caught on a revolving shaft or other moving part of picked up by static electricity generated by a moving belt presents a special accident prevention problem when students with long hair work anywhere around moving machinery. Various forms of protection for women's hair have been developed and tried out. Attractively designed caps have proved effective and have been well received. They should be made of durable fabric to withstand regular laundering and disinfecting. The design should be simple so that they can be pressed or ironed by machine. A visor long enough and rigid enough to provide warning before the head strikes an object which might cause injury is advisable. A range of sizes sufficient to insure good fitting is important.

Ear protective devices are being used more and more in establishments where noise cannot be reduced at its point of origin. Ear protectors are designed to provide maximum ear protection by filtering out and absorbing harmful noise in both the high and low frequency. It is generally recognized that ear plugs alone significantly reduce noise at the eardrum. An ear muff attempts to seal out noise by providing a tight fit around the ear. Ear plugs should be individually fitted to the wearer. They are somewhat difficult to detect from a distance and should be inspected to insure that they are being worn where needed. The attenuation of noise by ear plugs is generally somewhat less than can be afforded by ear muffs. Ear muffs may be foam filled or grease filled. The latter costs somewhat more but are the most effective in attenuating sound pressure levels. Ear muffs are substantially more expensive than ear plugs and are more bulky but are sometimes more comfortable to wear.

Hand, Foot, and Leg Protection

Accidents to hands, legs, and feet account for approximately 60 per cent of all disabling industrial injuries. In the school shop, injury to fingers is probably the most frequently occurring accident. Because it is necessary to handle work, the fingers are almost continually subject to injury. Legs and feet normally receive fewer injuries in the school shop, but even so, protection should be provided where the nature of the work permits such injuries to occur. A survey of the shop area will indicate where hand, foot, and leg protection should be worn.

Gloves and Hand Leathers

Canvas or heavy cotton work gloves are usually worn if the main hazard is blisters due to friction. Such protection is inexpensive and easily procured. When heat is involved, such as in foundry work, a more protective type of glove or mitten should be worn. Asbestos gloves or mittens are designed for the very hot jobs and made of long fiber asbestos cloth. For welding, a leather glove extending well over the wrist is recommended. Some of the more durable ones are made of cowhide or horsehide. Hand guards or leathers are usually of a special design to reduce hazards when handling material with sharp edges, such as sheet metal or steel. They consist of a pad of leather which covers the palm of the hand and fingers, yet permits maximum hand flexibility. For protection against acids, caustics, solvents, and petroleum products, an appropriate impermeable glove, available in various types of rubber or plastic, should be used. Such gloves can be purchased in wrist or gauntlet length. The gauntlets vary in length and extend to a few inches above the wrist or to the entire length of the arm, as required. Gloves should not be worn around moving machinery.

Foot Protection

A great majority of foot injuries occur from dropping heavy objects on the feet and getting toes caught under heavy objects as they are lowered. Safety shoes with steel toe boxes have been designed to prevent injury when such accidents occur. The modern safety shoe is quite stylish, and usually cannot be detected from ordinary street style oxfords or ankle high shoes. The difference lies in the hidden steel toe box installed in the shoe. Safety shoes do not cost much more than regular shoes, and a well-made and properly fitted safety shoe is as comfortable and stylish as any other. Some retail stores now render a special fitting service for safety shoe buyers. Externally worn foot protectors which slip over regular shoes are also available.

Leg Protection

Leggings of knee or hip length provide additional protection against spark, acid, and metal splashing. Foundrymen in particular should be concerned with the protection offered by leggings when pouring molten metals. Knee-length leggings are usually secured by means of a spring clip which makes them easy to put on and wear. A tuck-in flap protects the back of the legs and, if properly designed, will fit well over the shoes. Such devices are usually made of either asbestos, leather, or flame-duck material.

Respiratory Protective Devices

In most school shops ventilation is usually more than adequate for normal operation of the class. However, in working with new materials, one must be aware of the possibility of air contamination and the possible need for respiratory protection for the safety and health of the students. The type of respiratory protective equipment must be selected only after determining the type of hazardous exposure involved. Undoubtedly, there have been many cases of injury caused by the improper use of respirators. For example, an ordinary filter type respirator designed for rock dust or paint spray will not protect against lead fumes; a canister respirator intended for carbon monoxide offers no protection when the air contaminant is carbon tetrachloride vapor. To aid in the selection of respiratory protective equipment the following procedures or steps should be taken:

1. Identify the substance or substances against which protection is necessary.

2. Obtain full knowledge of the hazards which each such substance offers and its significant properties.

3. Determine the conditions of exposure involved, including duration of exposure, contaminated concentration, and oxygen content of the air.

4. Determine what, if any, personal characteristics and capabilities are essential for the safe use of the protective devices and procedures required.

5. Determine what facilities are needed for maintenance.

Finally, in view of these conditions, select the type or types of U.S. Bureau of Mines-approved respiratory device best calculated as adequate protection against the specific hazard and conditions.

Filter Respirators

Probably the most needed type of respiratory equipment in the school shop is for paint spray and fumes. This type of respiratory protection consists of a face piece or a half mask shaped to fit the contours of the face and equipped with a filter designed to trap fine particles of dust and paint from the air as it is inhaled, but must be carefully selected as indicated above for protection against specific hazards under specific conditions. Filter respirators are available for several types of dusts, fumes, and mists. Care of mechanical filters is simplified by selecting a model that can be easily cleaned, disinfected, and repaired. Naturally, no one wants to use a respirator that has been worn by another person until it has been disinfected. The manufacturer's directions should be followed in properly preparing a respirator for use by more than one person.

Other Respirators

Other respiratory devices of an oxygen or canister type are available for severe hazards of fire fighting and complex industrial uses. It is unlikely such equipment will be needed for school shop protection, except in an emergency. In fact, if the hazards are determined to be great enough to warrant use of this type equipment, the hazard should be eliminated or removed from the instructional program. In chemical laboratories the possibility of requiring emergency respiratory protection, including the self-contained type of breathing apparatus, should be carefully evaluated well in advance of need.

Protective Clothing

Auxiliary protection of a less spectacular type worn in many school shops consists of shop coats, aprons, coveralls, and overalls. These items serve as much a part of proper dress for specific job operations as do safety devices previously mentioned. Each has its specific function which should be considered as part of the total personal protective program.

Shop Coats

Shop coats give general body protection. Frequently they are used to safeguard against grease and dirt. More specifically, they serve as protection from chemicals and hot substances. Coats with sleeves should not be used when working around moving machinery. The short sleeve wrap-around knee or hip length serves well for general laboratory or shop use.

Aprons

Aprons, available in a variety of materials, may be either the bib type covering from the chest down to the knees or ankles or of the waist type. Aprons protect against sparks, hot metal splashes, and splashing liquids depending on the material from which they are made. Loose aprons create an extremely hazardous situation when worn around revolving or reciprocating machinery. This practice should not be permitted.

Coveralls and Overalls

Coveralls cover the body except for the hands, head, and feet. Overalls include a "bib" but do not have sleeves as provided in coveralls. They are usually made from a rugged material to withstand hard and long wear. Coveralls and overalls provide body protection and are recommended for building construction jobs.

EMERGENCY ACTION PLANS

No school shop or laboratory is immune from emergencies. Therefore, emergency action planning is not a luxury–it is good insurance. Emergencies can arise at any time and do not have to be caused by spectacular occurrences. Fire, explosions, single or multiple work accidents are the types of emergencies which can occur without warning in school areas devoted to the development of manual skills or technical knowledge. Regardless of the size or type of the educational organization, the school administrative and advisory staffs are responsible for developing and implementing an emergency action program designed to meet all eventualities. Such an emergency action plan requires the same organization and administration as any other educational undertaking. There is no one emergency plan that will do all things for all organizations,[23] and each educational unit must therefore decide on a plan that fits its needs and can be afforded. Edward A. Campbell says that "in planning for an emergency the following are important:[24]

1. **Fire alarm and fire exit drill plan.** Manual pull boxes that activitate the school fire alarm should be connected to the municipal fire alarm, and an exit plan should evacuate the students to safety in two minutes or less.

2. **Fire extinguishers** (first aid type) for Class A, B, and C fires should be strategically placed. All laboratories should be completely equipped with automatic sprinklers and/or fire and smoke detectors.

3. **First aid kit,** approved by school physician.

4. **Fire blankets** should be strategically placed where there is a danger of clothing fire.

5. **Eye wash fountains and chemical showers** in areas where hazardous chemicals are stored and used.

6. **Stretchers** should be available to move the injured.

7. **Telephone communication** may be necessary to summon help.

8. **Resuscitation equipment** should be available in the school.

Emergency action plans in school shops and laboratories include four important elements: 1) a work accident procedure, 2) an evacuation procedure, including fire drills, 3) alarm systems, and 4) first aid treatment.

Accident Procedure

The following is an example of a procedure, prescribed on the Los Angeles School District[25] to be followed by the school administrator or his representative in the case of a serious accident resulting in injury to a student or students:

1. Refer the student to the school physician or nurse if either is in the school. If neither is available, give first aid.

2. Notify the parent immediately to obtain the parent's directions concerning action to be taken.

3. If the parent cannot be reached, follow the instructions on "emergency hospitals."

4. If the parent cannot be reached, and the emergency hospital assumes charge of the case, notify the parent of this fact at the earliest opportunity.

5. The principal or his designated representative, except custodial employees, shall accompany the student to the hospital and where possible remain with the student until the parent arrives to assume charge.

6. In the case of a fatality to a student, notify the parent and the police, and telephone the information to the business division.

7. The following procedure is to be followed in case of puncture wounds from rusty nails, sharp instruments, etc.: sterilized gauze is the only dressing to be used on such wounds. Parents should be advised that the student should be taken to the family physician or to the county hospital for treatment and to determine the need for tetanus anti-toxin injection.

The Los Angeles Administrative Guide also includes the following procedure for use when serious accidents occur in post-high school industrial education evening classes (not applicable to secondary schools):

1. Contact the school administrator or his representative immediately in the event of a serious accident. He will assume responsibility.

2. In the event the school administrator or his representative cannot be contacted, request another teacher to assume responsibility for your class until the emergency is over. If the substitute teacher does not have an industrial education credential in the subject area, instruct him to keep all power machines and equipment turned off. Give first aid to the student, then call a doctor for further instructions. In the event a doctor cannot be contacted, telephone the policy emergency hospital to send an ambulance.

3. In the event of a less serious accident, the following procedure will be followed: Ask the injured pupil whether he wishes to 1) call for a relative or friend to take him home or to a doctor, 2) have one of his classmates take him home, or 3) call a taxi to take him home.

Building Evacuation

The plan of action for evacuating the school building in the event of a fire or other emergency will be prepared by the school administration on a school-wide basis. Such a plan should be reviewed by all faculty and posted in a conspicuous place in the school shop or laboratory and should include a supplemental set of instructions regarding the procedure for the evacuation of the specific area. The teacher has the responsibility instructing the students in his class on the procedure of evacuating the shop or laboratory area. In addition to periodic "shop talks" and demonstrations given by the teacher, fire drills should be practiced often by the students. The Pennsylvania Department of Public Instruction has recommended that the following be included on a basis for fire drill instruction:[26]

1. Every student should be thoroughly familiar with the fire signal for all drills.

2. Every student should know the location of fire extinguishers and other fire fighting equipment.

3. Every student should know the exits for leaving the building from all shops.

4. Every student should stop activity and conversation at the first signal and leave the shop as directed and in as orderly a fashion as possible.

5. Every student using a machine should turn off the power immediately even though the work in the machine may be spoiled.

6. Every student using an electric soldering iron should disconnect the iron and place it in a holder in the event of a drill.

7. Every pupil should be alert and follow instructions at all times.

The National Safety Council lists the following as statements which might be placed on an emergency exit notice for general posting in case of fire or other emergency:[27]

1. **Keep your head**–Avoid panic and confusion.

2. **Know the location of exits**–Be sure you know the safest way out of the building no matter where you are.

3. **Know the location of nearby fire extinguishers**–Learn the proper way to use all types of extinguishers.

4. **Know how to report a fire or other emergency**–Send in the alarm without delay.

5. **Follow exit instructions**–Stay at your work place until signaled or instructed to leave; complete all emergency duties assigned to you and be ready to march out rapidly according to plan.

6. **Walk to your assigned exit**–Maintain order and quiet; take each drill seriously–it may be "the real thing."

Alarm Systems

Noise in a school shop or laboratory can be considered a hazard for several reasons. One of these is the inability of the teacher to attract the attention of his pupils during emergency situations. Where such noise is a real factor, the teacher should employ some type of alarm to command the attention of his entire class when necessary. The warning device should not be harsh enough to startle the students into committing an unsafe act, but should be just loud enough to be heard throughout the shop area.

There are a number of major types of electrical industrial signals available. They differ in recommended use, tone, and range of signal. The National Safety Council lists the following types of signal equipment which are available:[28]

1. **Horns** are probably the most frequently used signals. They have loud sharp, clear, defined tones and a wide range of power, making them suitable for use in a variety of industrial, commercial, and institutional areas. Units are available for interior or exterior installations and may operate electrically, manually, or pneumatically.

2. **Sirens** command the most attention and have the longest effective range. Some sirens may be heard up to three miles, are audible above almost any surrounding noise, and are especially effective in outdoor locations.

3. **Bells**, the most versatile of all industrial signals, come in a broad selection of sizes and tonal ranges. Larger models can be used for fire alarms as well as burglar alarms.

4. **Buzzers** find application in signaling and alarm systems of public buildings, hospitals, offices, and other locations where a more startling signal would be out of place.

5. **Chimes** should be specified for locations where a low noise level is required, such as offices, banks, or hospitals.

First Aid

Most educational institutions have established policies for dealing with student injuries and illnesses and with the administration of first aid. All shop and laboratory teachers should become familiar with the policies of their particular school systems, so that they can act effectively and efficiently in case of student injury. Such policies are established primarily to assure the student a prompt and adequate treatment. However, they also prevent school personnel from taking any action for which the school administration is unwilling to accept legal responsibility. These established policies and procedures should be posted in the activity area so that all can see and act accordingly.

In schools where nurses are in attendance, it is preferable that they be delegated the responsibility for first aid because of their specialized training and experience. However, even if a nurse is available in the school, teachers should be qualified in first aid so that precious minutes can be saved in an emergency. Delay in caring for even small cuts and scratches can also have serious results.

The practice of permitting a student to care for his own injuries must be discouraged. The teacher should be informed about every classroom injury. Likewise, indiscriminate use of the first aid kit by students must be discouraged; it should be used only under supervision. The limitations of first aid must be thoroughly understood, and it is important that the teacher, or one appointed by him to look after school shop first aid work, have a full understanding of these limitations.

There is general agreement that every school shop and laboratory should be equipped with a well-stocked first aid kit kept under supervision. However, the teacher should definitely determine the policy of the school administration regarding giving first aid in activity areas. There are three types of first aid kits which could be used in the school shop and laboratory situation:

1. Emergency kits containing only the essential articles for immediate treatment of injuries.

2. Group or departmental kits for the use of groups, shops, or for a single department containing larger quantities of first aid articles.

3. First aid room kits of a somewhat larger type, for use under the supervision of medical personnel.

Green has been specified by the United States of America Standards Institute as the basic color for designating "safety" and the location of first aid equipment. Such equipment includes first aid kits, safety bulletin boards, stretchers, first aid dispensary, and gas masks. The white cross on a green background identifies cabinets containing first aid materials. Such cabinets should be dustproof, clean, and well stocked with approved first aid materials. Maintenance of materials is simplified if each cabinet or kit contains a list showing the original contents and the quantities below which new materials should be ordered. The periodic and scheduled inspection of first aid kits should be the responsibility of the teacher, assisted by an assigned responsible student.

INSPECTIONS

Safety inspections are a necessary segment of a complete accident prevention program. They are essential to maintaining acceptable standards of safety for physical facilities and working practices. Conditions in school shops and laboratories are constantly changing. Materials are moved, storage racks are depleted, waste materials accumulate, and machine, hand tools, and other equipment are constantly changing as a result of use, wear, or abuse. Changes also result from student turnover from one class period to another and from the student's progression from one activity to another. Safety inspections are a means of surveying and appraising the problem of unsafe conditions and work practices which result from these many types of changes.

Types of Inspections

There are several types of inspections which should be employed in the school shop and laboratory situation. They may be classified as follows: 1) periodic inspections, 2) intermittent inspections, 3) continuous inspections, and 4) special inspections.

Periodic Inspections

Periodic inspections are those which are scheduled to be made at regular intervals. Such inspections may be made daily, monthly, semi-annually, annually, or at other suitable intervals. Such inspections should be well planned, so that they may be made with dispatch and efficiency. A "suspense" file should be set up so that those individuals involved can be notified beforehand to make the necessary preparations.

Periodic inspections may be in the form of **general inspections.** A general inspection will cover the entire school shop situation, department by department, room by room, machine by machine, operation by operation, until the most remote corners of all the facilities have been thoroughly investigated, not excluding those places where no one ever visits and where no one ever gets hurt. Many of these out-of-the-way places are overhead, where it is difficult to see the hazard from the shop floor.

Periodic inspection may also take the form of **fire inspections.** One of the greatest hazards to a school plant is fire. Consequently, a rigid system should be set up for periodic inspection of all types of fire protective equipment. The schedule for inspections should be closely followed and an accurate record kept of each piece of equipment inspected and tested. Along with the scheduled inspection, the adequacy and type of equipment needed should be carefully surveyed. As new operations and processes are added to the shop or laboratory curriculum, new fire hazards may be introduced. These new devices and procedures will require individual treatment and may need special extinguishing devices.

Other periodic inspections include the regular checking of floors and flooring. At the same time, attention should be paid to fall-causing hazards such as slippery, wet, oily, and worn floors; loose material underfoot; worn or broken treads on stairs; insecure scaffolds and platforms; stairs, scaffolds and platforms with no hand rails; defective ladders or ladders not suited to the job; unguarded floor openings and manholes.

Many types of tools, machines, and processes require periodic inspections if they are to be operated safely. Some shop teachers require the tool clerk to make a safety check of all tools and accessories when they are returned to the tool crib for storage and again before reissue. Some teachers send all portable electric tools and extension cords to the electric shop between the first and tenth of each month. In the electric shop, students inspect the tools and make the necessary repairs. Colored tags are attached to the tools or cords showing the month the equipment was last inspected.

Intermittent Inspections

These are inspections which are made at irregular intervals as the need arises. They may be unannounced and deal with a particular shop, laboratory, or a specific piece of equipment. The need for this type of inspection is frequently indicated by the accident tabulations and analysis. Should an analysis show an unusual number of accidents for a particular location or an increase in certain types of injuries, inspections should be made to determine the reasons for the increase and the necessary corrective action.

Continuous Inspections

These are inspections set up so that selected students spend a predetermined amount of their time observing or inspecting certain equipment and operations for hazards and unsafe practices. Such students are often called safety foremen. This type of inspection should be rotated so that all qualified students will have a part in the safety activity, thus making a contribution to the accident prevention program. This method of inspection provides an opportunity for students to become familiar with the exact safe condition of tools and machines. It enables the students and the instructor to learn of weaknesses and defects long before they can become hazardous. A continuous system of inspection of personal protective equipment is especially desirable. A constant check of protective goggles, respirators, gloves, and other protective clothing will insure the maintenance of this equipment in safe and usable condition.

Special Inspections

These inspections are sometimes necessary because of the installation of new equipment, the introduction of a new operation or process, the remodeling or repair of a piece of equipment or shop facility, or because new situations or circumstances introduce new hazards. Special inspections may also be made during campaigns such as Fire Prevention Week, waste elimination campaigns, prior to a shop "open house," or other special programs. The investigation of accidents requires special inspection conducted by assigned individuals. Such inspections should be made with thoroughness and a determination to control accident causes.

The **health survey** is a type of special inspection made [illegible] determine the extent of suspected health hazards and to determine precautions or mechanical safeguarding necessary to provide and maintain safe conditions. It may be necessary to call [illegible] health department specialists to conduct this type of special inspection.

Safety Inspectors

Although the principal purpose of safety inspections is hazard detection and correction, there are numerous worthwhile side effects. Involving students in these inspections helps to teach the duties of the industrial foreman in accident prevention. Involving teachers and educational supervisors demonstrates the interest and sincerity of these school authorities in the continued safety of students enrolled in shop and laboratory programs. When representatives of industry or governmental agencies are also involved, the students are likely to adopt a more positive attitude toward the accident prevention program as a whole and use their own initiative in detecting unsafe conditions and work practices.

Safety inspections in schools may be made by 1) school personnel, 2) industrial safety engineers, 3) inspectors from state departments of labor and industry, 4) state or local fire inspectors, 5) student safety committees, and 6) student inspectors or foremen.

School Personnel

This group might include educational administrators, supervisors, or teachers on a state or local level. State directors, supervisors, teacher educators, or coordinators of vocational education can be invited to serve in special inspections when the interests of the state-wide shop and laboratory program are involved, or when there is an unusually high accident rate. Local vocational supervisory personnel should be employed also to a considerable extent in periodic and/or special inspections.

Industrial Safety Engineers

Professional safety engineers in local industries can aid greatly in making a school shop inspection program more effective. These individuals, serving voluntarily, have training and experience in organizing and operating safety inspection programs. It is advisable, however, to make arrangements well in advance of the school year if the service of these men is to be expected.

State Labor Department Inspectors

The shop and laboratory teacher should become familiar with the accident prevention services available from his state labor department. These services will vary from state to state, but the teacher will find these officials most cooperative. In most states labor department inspectors are only available on request.

Fire Inspectors

Persons who make fire prevention inspections should be particularly well informed and sensitive to hazards which may cause fires. Local fire departments are usually anxious to cooperate with fire prevention in schools. As a part of periodic inspections, it would be well for shop teachers or supervisors to invite representatives of local companies to inspect for hazards and to give technical advice on fire prevention.

Student Safety Committees

The student safety committees can be formed either on a school-wide basis or on a shop or laboratory basis. The latter plan provides an opportunity for more shop students to participate, resulting in greater educational benefits. The most important duties of such a committee are inspection of the shop area for accident hazards and unsafe practices and the investigation of the shop area for accident hazards and unsafe practices and the investigation of accidents to prevent recurrences.

Student Safety Foremen

Many shop and laboratory teachers find it helpful to appoint a student safety foreman to assist in carrying out the shop safety inspection program. A student safety foreman is especially useful in the continuous type of inspection. All qualified students should have the opportunity of serving in this capacity by means of a rotation system. When serving as an inspector, the student should devote the majority of his shop time to accident prevention work; necessarily, his tenure in office will be brief in order not to interrupt his own shop training.

Inspection Procedure

Inspection procedures will vary considerably with different shops and with the types of inspections made. The primary objective of a well-balanced inspection program should be to determine whether everything is satisfactory, rather than to find out what is wrong. Procedures followed in safety inspections are comparable in many respects to those followed in preventive medicine. The steps include the following:

1. **Detect.** Examine the shop and its activities for possible hazards and unsafe practices. (examine the patient for symptoms of illness or disease.)

2. **Analyze.** Analyze the particular hazards or unsafe practices for potential accident producing capabilities. (Diagnose)

3. **Correct.** Recommend the corrective measures. (Write the prescription or advise the necessary action to avert illness.)

Preparation is an essential requirement for effective safety inspections. Before one starts the inspection, the shop's accident history should be completely analyzed. This analysis should show the number of accidents, agencies involved, the nature of the injuries, and the accident causes. Attention should also be given to "near" accidents, and previous inspection reports should be reviewed. Emphasis should be made on causes, not blame, and an attempt should be made to discover why the condition exists, as well as what the condition may be. Complete notes should be taken during the course of the inspection. These notes will form the basis for a report to be prepared later. As unsafe conditions and practices are discovered, they should be discussed with the instructor or shop supervisor and suggestions for corrections solicited. A definite policy should be established in regard to placing unsafe equipment out of service. Special danger tags can be employed effectively in preventing the use of machines and tools that have become unsafe, through wear, abuse, or defects. However, such practices should be employed under the strictest supervision.

Inspection Checklists

Numerous state and local school systems have developed safety inspection checklists adapted to their own needs. The National Commission on Safety Education of the National Education Association has published a general checklist of safety education for schools. This list can serve as an excellent guide for the preparation of shop or laboratory safety inspection checklists. In preparing such an inspection checklist, the number of basic factors depends upon the size of the shop or laboratory and the educational activity conducted in the area. The U.S. Department of Labor suggests the following as being a minimum of things to be investigated in industry:[29]

1. The condition of the building and facilities.
2. The layout of the work area with respect to the location and guarding of machines and equipment.
3. The access to and from the work area and the adequacy of aisles and storage areas.
4. The flow of the materials through the shop, including the disposal of scrap.
5. The handling of materials.
6. The control of hazardous materials.
7. The control of hazardous processes.
8. Lighting, noise, ventilation, heat and humidity, vibration, and other related environmental exposures.

AVA-NSC Checklist

One of the most objective safety checklists available to shop teachers today is the *National Standard School Shop Safety Inspection Checklist* prepared by the joint safety committee of the American Vocational Association and the National Safety Council. This four-page form is available from the National Safety Council at a very nominal price. An example of this form is shown in Appendix H of the guide. Use of this checklist is to be encouraged by school administrators. Implementation of the use of this instrument will require an organized action program with support and leadership from state educational agencies, from local educational leaders, and from teacher education institutions.

Summary

A very few basic factors are involved in any realistic school shop or laboratory inspection program. These may be summarized by three questions:[30]

1. **Who inspects?** The answer to this question is determined by local administrative policies. Some teachers feel that they are not qualified to make adequate safety inspections. This may be true, but a checklist will simplify such a task by providing a guide to insure that hazardous conditions are not overlooked. The American Society of Safety Engineers, through its local chapters, has volunteered the services of its members to strengthen school shop safety education programs. Such experts can assist in the inspections of school shops.

School personnel have the moral and legal obligation to provide a safe environment for the shop student. An inspection team of teachers appointed by the administration can inspect all shops in the school system. An inspection committee of students can be appointed by the teacher on a rotation basis. Such student participation has many recognized advantages. If student committees are used, the reports of their inspections must be given careful consideration and not "tabled" permanently. Faults must be corrected and at once. If recommendations cannot be implemented, logical and substantial reasons must be shown and appropriate alternative steps taken. Otherwise, the student's respect for the teacher, the school administration, and safety programs in general will be lost.

2. **When are inspections made?** At least one thorough safety inspection of every school shop should be made at the beginning of each semester of the school year. Other less formal inspections, including such things as housekeeping and the condition of hand tools and machines, should be a part of the daily routine of the shop program.

3. **What about follow-up?** The follow-up of safety inspections is just as important as the inspection itself. Unless conditions revealed by the inspection are corrected, the inspection is of little value. A record of conditions should be made on the dated checklist. A current report should be compared with previous records to determine progress and the report studied in terms of accident prevention, so that special attention can be given to "accident producers." The unsafe condition should be corrected as soon as possible in accordance with local procedures. The date that the correction is made should be recorded on the checklist. A definite policy must be established in regard to placing unsafe materials and equipment in areas out of service. Such policies will require strict supervision and enforcement. The inspection report should be used to advantage by the teacher as a subject for class discussion. In addition to stimulating cooperative action and maintaining a safe environment, such discussions reinforce the desire and willingness to work safely.

ACCIDENT REPORTING AND ANALYSIS

An organized system of accident reporting and analysis can contribute materially to the success of the school shop and laboratory accident prevention program. Such a system, however, is much more than a simple amassing of data. It is the discovery and investigation of facts pertaining to an accident, an analysis of this data, a deduction of the underlying causes, and a consideration of possible corrective action.

An excellent publication entitled *Student Accident Reporting Guidebook*[31] is available to state and local administrators from the National Safety Council. This guidebook discusses in detail every facet of an accident reporting system. It tells how to develop a report form, how to compile data, and how to use the information. It briefly discusses how elements of a safety program affect the reporting system. It offers a standardized terminology, definitions of accidents and injuries, and rate computations. All are designed to make it easier for school personnel to understand their own accident experience, and to be able to look at local and national information with more understanding. The balance of this section of the guide will briefly summarize the basic elements of the National Safety Council guidebook.

Use of Reports and Records

There are literally hundreds of uses for accident data. The teacher, the nurse, the principal, the safety supervisor, the departmental supervisor, the superintendent, the board, and the community all can effectively use information from school accident records and reports. Specifically, the systematic accumulation of school and non-school jurisdictional accident and injury data will provide the school superintendent with information upon which to base:

1. Curriculum guidance to educate the child for safe living.
2. A realistic evaluation of safety program efforts on a regular basis.
3. Changes in building structures and facilities or procedures to improve the environment of the school system.
4. Organizational and administrative improvements to strengthen the management aspects of the safety program.
5. A strong public relations program, thus lessening public demands for crash programs of little value, should unusual incidents occur.
6. A strong leadership role in community safety efforts.
7. An assessment of the costs of accidents and injuries and their relationship to the operating expenses of the school system.

Individual accident reports can be useful at any level of the school system for positive action (including defense of a lawsuit following an injury), and they should be reviewed carefully at each level through which they are processed. The principal has many uses for an individual accident report. For example, he may use the report to:

1. Check on what is happening in his school.
2. Spot an unsafe condition or unsafe procedure which can be corrected locally by the custodian or by the principal himself; the report can provide the basis for a work order for repair and maintenance of facilities.
3. Initiate special safety studies within the school.

4. Strengthen staff interest in accident prevention activities by having members of the staff, such as the faculty safety coordinator, nurse, or custodian review the report and make recommendations.

5. Establish a repeater file, and also note the accidents in the student's personal folder for reference throughout his school years.

The school system's safety supervisor is normally the next person to review each report. He may use the report to:

1. Spot unsafe conditions or deficiencies not recognized at the school level and which can be corrected at his level.

2. Initiate special studies when unusual accidents appear.

3. Watch for trends in normal activities so that immediate analytic and preventive action can be taken in cases of rising trends.

4. Initiate procedural studies and changes.

5. Emphasize a particular subject area in regular or special bulletins.

6. Alert supervisors in other departments, such as physical education, elementary, industrial arts, science, and medical departments, to incidents relative to their specialty and to ask for their recommendations or suggestions.

7. Spot weaknesses in the reporting procedure which can be corrected or minimized.

8. Screen out unusual occurrences which will provide a little levity or change of pace for bulletin material.

9. Keep the superintendent fully informed of serious or unusual incidents in case of inquiry by the board or other local officials.

10. Keep the business or law office informed of reports which may have legal implications.

11. Establish a repeater file at the school system level for the purposes of special studies.

Use of Monthly Summary Reports

Although individual accident reports may not be too meaningful, when they are viewed as a group they may be very useful in that they can reveal patterns. Therefore, reports should be accumulated, compiled, analyzed regularly, and summarized monthly. Within the school, summaries may serve a number of purposes. The principal can use the reports as the basis for:

1. Initiating special projects for the student safety council or the safety committee of the student council.

2. Initiating special studies of problem areas by teachers, parents, or students.

3. Requesting assistance from the consultant staff to solve special school safety problems.

4. Comparing current accident experience with past records to determine trends.

5. Reviewing course material within the school classes and activities in order to insure proper emphasis on safety.

6. Discussing school safety problems with the teachers and administrative staff at the principal's regular meetings.

The safety supervisor can make substantial use of monthly summaries. Here are some of the more important uses:

1. To identify the principal types of accidents, where and why they are occurring, and what to do about them. Corrective action may take various forms: improved instructional material; increased teacher education; changes in procedure or supervision; additional safety instruction; or structural or physical changes in the school environment.

2. To compare the accident experience this month to corresponding previous months. Was it up or down? What areas have improved or retrogressed? What are the general trends and causative factors involved? Are there any schools which appear to have an uptrend from the previous month?

3. To use observations and findings as a basis for special emphasis material presented to principals and teachers through monthly safety bulletins or other media.

4. To prepare a short synopsis for the superintendent to keep him abreast with his program. Give him brief facts and figures meaningful from a management standpoint.

5. To keep the departmental-level staff informed of accidents and trends within their area of interests. Encourage continuing interest and action on their part.

6. To watch for trends as a basis for special and continuing studies.

Use of Yearly Summaries and Analyses

Yearly compilations and analyses can have broader implications in many cases, because they present a greater body of material than do monthly summaries. Almost all the uses of monthly summaries also pertain to yearly summaries, and the same principles for use are involved. Some additional ideas for use of annual data include:

1. The preparation, publication, and distribution of annual reports to schools, consultant staffs, school boards, superintendent, and outside agencies.

2. Use trend analyses to determine planning for the next year, and for instigation of special studies for curriculum planning.

3. Encourage individual schools to summarize and analyze their own reports on a yearly basis, utilizing the same principles as for monthly reports.

4. Analyses of data can be used for justification to the superintendent and board of education of additional safety staff or additional funding. The safety supervisor is in the best position to present a case for staffing to the superintendent.

5. Yearly analyses can provide data for improvements in school construction or modification.

6. Accident reporting procedures should be reviewed each year, and summaries may indicate that a change in some procedure is needed.

7. Annual reports can indicate a need for additional education or change in emphasis for students and staff.

8. Annual reports must be used as a factor for appraising a school's progress in an overall safety program.

Reportable and Recordable Accidents

Basic to the establishment and standardization of a reporting system is an understanding of terms and definitions. The definitions given below should be thoroughly studied and understood before proceeding. Discussion of the terms will follow the definitions to amplify the concept.

The purpose of distinguishing between types and severity of accidents is twofold. First, to provide the school with information relative to all school jurisdictional accidents and with non-school jurisdictional accidents causing injury to pupils; and second, to provide a standard method with a common base in order to compare and analyze accident and injury data within the school system, with other school systems, or with national statistics. The terms used to distinguish these purposes are *reportable* (any accident for which a report is filled out) and *recordable* (any accident to be included in standardized statistical treatment of the data).

Reportable Accidents

A reportable accident is:

1. Any school jurisdictional accident which results in any injury to a student and/or property damage; or

2. Any non-school jurisdictional accident which results in injury causing restriction of activity of the student.

School jurisdiction includes school buildings, grounds, to and from school, and school-sponsored activities away from school property. The concept of property damage includes damage to the school's own equipment, material, or structures, or damage to non-school property as a result of a school jurisdictional accident. Non-school jurisdiction or sponsorship of the school such as homes, and public buildings. Restriction of activity implies a loss of one-half day or more of school time or a loss of one-half day or more of normal activity if during a non-school period.

Every school system should require a preport of some kind on the accidents they consider as reportable. It is essential that a school system know of all accidents occurring under the school's jurisdiction. This is sound management procedure, and it offers some protection for the school in areas where liability may be a factor.

Recordable Accidents

A recordable accident is any accident which results in: 1) student injury severe enough to cause loss of one-half day or more of school time; or 2) student injury severe enough to cause loss of one-half day or more of student activity during non-school time; and/or 3) any property damage as a result of a school jurisdictional accident. For standardization a one-half day loss of school time is defined as one half of the normal school day for the particular student involved.

"Reportable only" accidents are not included with recordable accidents for the purpose of summary and analysis as there can be no standardization either within or without a school system if it is done. The number of local and other influences, even in individual schools within a school system, precludes the feasibility of this practice. Thus, identifying a recordable accident provides a basis for a standard method for summarizing and analyzing accident and injury data; not only within the school system itself but with other systems, and with state, regional, and national figures. Recordable injuries and accidents, therefore, are used as the basis to develop summary charts and perform statistical analysis.

Accident Report Forms

It is recognized that there is no one report form that will satisfy the needs of every school system. There is no one format that can be said to be better than any other, but the report form should be simple and as easy as possible to complete. In addition, there is a required body of information which is basic to the analysis and utilization of accident and injury data if the report is to have any value for accident prevention purposes.

For information and background, the items which should make up the minimum content of an accident report form are herein defined. The terms used are consistent with accident reporting terminology used in accident prevention work throughout the country. Their use in school reporting systems helps to standardize terminology and makes it much easier for written and verbal communication among safety personnel. As a further aid to understanding each of these general classifications, they are shown on a sample accident report form and appear as Figure 9 of this guide. Items 4 through 24 are described below:

4. **Sex.** Indicate "M" for male; "F" for female; "unknown" for unknown; or "NA" for not applicable. The "NA" will indicate property damage accidents with no personal injury involved.

5. **Age.** State age of the student at his last birthday.

6. **Grade.**Indicate the grade level such as K for kindergarten, 1-for first grade, 2-for second grade; special education; adult education; junior college. If it is a special program such as "Headstart," student work program, adult retraining or preprimary, indicate each.

7. **Date, time, and day of accident.** Indicate the month, the day of the month, the year, the exact time, a.m. or p.m., and the day of the week the accident occurred.

8. **Nature of injury.** Indicate to the best of your knowledge what the injury was, such as burn, fracture, abrasion. If multiple injuries, list only the most serious.

9. **Part of the body injured.** Indicate the part of the body injured such as lower arm, ankle, scalp. If more than one part of the body is injured, indicate the most severe or list it as a multiple injury.

10. **Degree of injury.**

    a. Indicate death if fatal.

    b. Permanent total or permanent partial disability if the injury results in the complete loss or loss of use of a body part or parts, such as the loss of an eye or the loss of a limb, amputation of a part of the body.

    c. Temporary total disability if the injury does not cause permanent disability, but causes the individual to lose one-half day or more of school or one-half day or more of normal activity if during a non-school period.

    d. No lost time if the injury did not cause permanent disability and/or loss of time or loss of activity.

    e. If degree of the injury is not immediately known, estimate or use a follow-up system. Reports should not be held up for lack of this information.

11. **Number of days lost.** Indicate, from one-half day or more, the number of days that the student was absent from school, or the number of days from one-half day or more that the student was restricted from normal activities if during a non-school period. For the purposes of this guide, a one-half day loss in school is defined as one half of the normal school day for that particular student. If lost time is not immediately known, estimate or use a follow-up system. Reports should not be held up for lack of this information.

12. **Cause of injury.** Identify the event which resulted in the injury such as "struck against moving object," "fall from elevation," "rubbed or abraded," "overexertion."

Jonesville Public Schools
ACCIDENT REPORT FORM

1. NAME ______________________ 2. ADDRESS ______________________

3. SCHOOL ______________________ 4. SEX ____ 5. AGE ____ 6. GRADE ____

7. DATE AND TIME OF ACCIDENT, DAY OF WEEK ______________________

8. NATURE OF INJURY ______________________ 9. PART OF BODY INJURED ____

10. DEGREE OF INJURY ______________________ 11. NUMBER OF DAYS LOST ____

12. CAUSE OF INJURY ______________________

13. JURISDICTIONAL CLASSIFICATION OF ACCIDENT ______________________

14. LOCATION OF ACCIDENT ______________________

15. ACTIVITY OF PERSON ______________________

16. STATUS OF ACTIVITY ______________________

17. SUPERVISION ______________________

18. AGENCY INVOLVED ______________________

19. UNSAFE ACT ______________________

20. UNSAFE MECHANICAL OR PHYSICAL CONDITION ______________________

____

21. UNSAFE PERSONAL FACTOR ______________________

22. CORRECTIVE ACTION TAKEN OR RECOMMENDED ______________________

____

23. PROPERTY DAMAGE ______________________

24. DESCRIPTION OF ACCIDENT ______________________

____

____

____

25. DATE OF REPORT ______________________

26. REPORT PREPARED BY ______________________ PRINCIPAL ______________________

Figure 9. Example of Accident Report Form.

13. **Jurisdictional classification of accident.** Indicate specifically whether accident was under school or non-school jurisdiction, such as school building, to and from school, home, or other.

14. **Location of accident.** Indicate the exact location of the accident.

15. **Activity of the person.** Indicate what the person was doing at the time of the accident.

16. **Status of activity.** Indicate the status of the activity at the time of the accident. For example, regular classroom period, physical education class, intramural athletics and practice, interscholastic athletics and practice, shop period, laboratory period, lunch hour period.

17. **Supervision.** Indicate whether an adult was present at the scene of the accident, and, if so, whether this adult was a teacher, another school employee, the parent, or another adult.

18. **Agency.** Indicate the equipment, substance, material, or the thing most closely related to the accident.

19. **Unsafe act.** Indicate any act on the part of the person or persons involved which may have caused or contributed to the accident.

20. **Unsafe mechanical or physical condition.** Indicate the primary unsafe mechanical or physical conditions, if there were any.

21. **Unsafe personal factor.** Indicate if there was any unsafe personal factor associated with the individual injured that may have contributed to the accident. Example: bodily defect, such as defective hearing; lack of knowledge, skill or experience, such as failure to recognize hazards; improper attitude, such as total disregard of instructions.

22. **Action taken or recommended to prevent further accidents of the same type.** Indicate what action was taken locally and/or (further) action recommended (i.e., action which may not be under the purview of local school personnel.

23. **Property damage.** Indicate in dollars the amount of damage, if any, to school and/or other property as a result of the accident.

24. **Description.** Briefly give a word picture of the accident, explaining the who, what, where, when, why, and how of the accident. Include such items as weather, equipment, unsafe conditions, unsafe acts, personal factors, and whether other persons may have contributed to the accident and how.

If the accident report forms are to be worthwhile for accident prevention purposes, the individuals completing and reviewing the report must know why they report accidents, how to fill out the forms, and what the items mean. Simple, clear, and meaningful instructions must be given to all concerned. Any, or preferably all, of the following methods can be used to disseminate instructions:

1. Duplicate the instructions in a safety handbook or in the administrative manuals, to be available in each school or other building.

2. Publish the instructions in separate written form, such as in pamphlet, a mimeographed bulletin, or printed instruction sheets for individual handout. This can be done in addition to the material already included in the administrative manuals, particularly if distribution of the latter is limited.

3. Print instructions on the back of the report form.

Summarizing Data

The two methods generally in use for compiling and summarizing accident data from accident reports are hand tabulations, and machine tabulations, known as data processing.

Hand Tabulating

Summary charts for hand tabulating should be simple and easy to tally from the accident report form. Enough room should be left in the blocks for tally marks. Some charts can be used as the basis for additional charts to accumulate the data by the month. The volume of the reports will dictate whether or not one of the summary charts might be used as the totals chart for the individual school and the system. School systems with many schools will have to use methods much different from those systems with few schools. The main principle will remain the same, that is, to obtain basic meaningful information in the way easiest for the particular school system. The format of the charts does not actually make too much difference. No two systems may have the same formats, but the end product is the same—the accumulation of useful information. The tally method is usable for hand tabulating, no matter how much volume you have, but more people and time are required as volume increases. The combinations of charts which can be used is almost limitless. Such items as sex, lost time, unsafe acts, the day of the week, and the like can have great value. Choose main selections of charts which, by further analysis of trends, will give clues for further summarizing.

Data Processing

Data processing is a tool for tabulating, sorting, summarizing, and printing all pertinent information. The safety supervisor is now provided with source material for analyses heretofore unavailable because of the time involved to gather, review, and sort all this information manually. School systems with 500 accident reports or more a year can economically convert to data processing. The use of data processing for tabulating and summarizing accident and injury data is described in detail in the National Safety Council's *Student Accident Reporting Guidebook.* This publication will provide the school administrator with general and specific classification of report form items and codes, together with a sample card layout for data processing. This guidebook also discusses in considerable detail other methods for evaluating and presenting accident experience.

State-Level Reporting

A few states within the United States have established methods of compiling accident data on a state-wide basis. This procedure is extremely helpful in providing state-level summaries and analyses for guidance of other state organizations and for the benefit of all school systems within the state. Some of the uses of state-wide accident statistics are:

1. To provide data for use in curriculum planning at the state Department of Education level.
2. To provide statistical information and program guidance for other state governmental agencies, such as the Bureau of Vital Statistics, Public Safety Department, and Board of Health.
3. To determine state-wide trends in accidents to school children and to develop preventive measures.
4. To assist in the compilation of national statistics.
5. To initiate special studies directed toward the reduction of student accidents in the state.
6. To encourage the summarization and use of accident statistics at the local school level in the state.

State-wide accident reporting is a vital part of a state department of education's program in safety education and accident prevention programming. It is feasible, and the results will be more than worth the effort required to initiate the program.

REFERENCES

1. William A. Williams, *Present Status and Preferred Practices in Safety Education in Pennsylvania Vocational Industrial School Shops,* (an unpublished doctoral dissertation, University of Pittsburgh, 1959).

2. Russell DeReamer, *Modern Safety Practices,* (New York: John Wiley and Sons, Inc., 1959) pp. 120-21.

3. Roland P. Blake ed., *Industrial Safety,* (New York: Prentice-Hall, Inc. 1943) pp. 301-302.

4. *Ibid,* p. 302.

5. Wayne P. Hughes, "Eye-Protection Legislation," *School Shop,* Vol. XXV, No. 6, February 1966, pp. 27-29.

6. Los Angeles City School Districts, Office of Board Services, 1959, *Administrative Guide,* Code 2370-2.

7. U.S. Department of Labor, Bureau of Labor Standards, *Safety Subjects,* Bulletin No. 67, p. 269.

8. Los Angeles City School Districts, Division of Instructional Services, *Safety Manual for Industrial Education Teachers,* Publication No. SC-601, p. 87.

9. National Safety Council, *Accident Prevention Manual for Industrial Operations,* 5th ed. rev., 1964, National Safety Council, 425 N. Michigan Ave., Chicago, 60611.

10. *Ibid,* p. 4-8.

11. *Ibid,* p. 4-8.

12. *Ibid,* p. 4-12.

13. Metropolitan Life Insurance Company, *Accident Prevention Can Be Learned,* (New York: Metropolitan Life Insurance Company, 1962) p. 23.

14. National Safety Council, *op. cit.* p. 17-2.

15. U.S. Department of Labor, Bureau of Labor Standards, *Maintenance and Safety,* Bulletin 246, p. 1.

16. William A. Williams ed., *Accident Prevention Manual for Shop Teachers,* (Chicago: American Technical Society, 1963) p. 168.

17. National Safety Council, *op. cit.* p. 33-16.

18. Williams ed., *op. cit.* p. 172.

19. Williams ed., *op. cit.* p. 203.

20. Williams ed., *op. cit.* p. 177.

21. U.S. Department of Labor, Bureau of Labor Standards, *Occupational Health Hazards,* Bulletin 198, p. 3.

22. Williams ed., *op. cit.* p. 327.

23. National Safety Council, *op. cit.* p. 35-2.

24. Edward A. Campbell, "Ready for an Accident," *Industrial Arts and Vocational Education,* Vol. 55, No. 9, November 1966, p. 64.

25. Los Angeles, *op. cit.* p. 11.

26. Commonwealth of Pennsylvania, *A Program of Fire Prevention in Schools,* Bulletin 399, (Harrisburg: Department of Public Instruction 1951) p. 120.

27. National Safety Council, *op. cit.* p. 35-9.

28. National Safety Council, *op. cit.* p. 35-15.

29. U.S. Department of Labor, Bureau of Labor Standards, *Control of the Physical Environment,* Bulletin 211, p. 2.

30. Williams ed., *op. cit.* p. 241.

31. National Safety Council, *Student Accident Reporting Guidebook,* 1966.

32. National Safety Council, *Fundamentals of Industrial Hygiene.*

CHAPTER 5

EDUCATION AND TRAINING FOR ACCIDENT PREVENTION

As commonly used, the terms "education" and "training" are given the same meaning.[1] The dictionary makes it evident that such usage is incorrect. *Education* is primarily the broadening of one's knowledge and understanding. *Training* is chiefly the development of skill or expertness in performance and manipulation. In accident prevention this distinction is important. Those individuals charged with the responsibility for the development of safe and adequate work behavior must have a sound understanding of what can be accomplished by safety education *and* by safety training, and know the methods proven effective for each.

SAFETY EDUCATION

Safety education is the process of broadening one's safety knowledge, developing an awareness of the importance of eliminating accidents and achieving mental alertness in recognizing and correcting conditions and practices which might lead to injury.[2] However, although basically true, this definition may be somewhat over-simplified. Many people do apply to their day-to-day activities, an occasional idea or aspect of knowledge which they have gained from a talk, poster, or book, especially ideas that can ease their work in some way or give them some immediate advantage. However, very few persons will systematically apply new knowledge to improve their work performance.

Few people will undertake to educate themselves on their own initiative, through systematic study. For the majority, an organized program of instruction–formal education–is necessary. Even this has little value unless the individual is receptive. The unwilling mind accepts few ideas and tends to discard quickly those it does accept, but the seeker of knowledge absorbs new facts and ideas rapidly and tends to retain them. If safety education courses are included as part of an accident prevention program for school shops and laboratories, a demand must be created for them or they will be of little value.

Emphasis is to be placed on the phrase "organized program of instruction." There must be systematic instruction and systematic study, which, of course, means definite study assignments and activity for each assignment. Examinations are necessary both from the instructor's and the student's standpoint. Without them, the instructor cannot determine his teaching effectiveness and student comprehension. Examinations, tests, and quizzes are of great value to the learner because they help him to retain the central ideas included in the course material. Proper safety education requires the services of safety education specialists competent both in their field and as educators. For this reason it is very difficult to present such courses using volunteer services alone; hence, they are usually limited to a small number of universities and colleges which have established safety education courses as a part of their resident or continuing education program of studies.

SAFETY TRAINING

Safety training is the process of developing one's skill in the use of safe work methods and in the application of safe practices to work activities.[3] Safety training can be described as a detailed extension of an accident prevention program applied to specific occupations, processes, jobs, or activities. Various methods of safety training have been tried and many of these have been quite successful in reducing accidents. In general, their success appears to be proportional to the degree to which they apply the principle that skill is achieved only by doing. The highly successful safety training procedure which appears in the U.S. Department of Labor's publication *Safety Subjects*[4] involves the following elements:

1. A safe method of performing each job operation or sequence of operations is developed and described in simple but adequate detail.

2. The various hazard points and the relationships between these hazards and the various steps in the safe method are clearly described.

3. The training is systematic and thorough and includes the following steps:

   a. Tell him.

   b. Show him.

   c. Have him do it.

   d. Correct him until he does it correctly (safely).

   e. Supervise him to see that he retains what he has learned.

4. The reasons for requiring personal protective equipment, such as goggles, safety shoes, and hand protectors, if needed, are explained, and their proper use and care taught in full detail.

5. Specific safeguards needed for the protection of the worker and his fellows are explained and their correct use taught. For example, individuals are trained to understand the proper use of point-of-operation guards on machines, steel mesh gloves in meat cutting, slip-on guards for the blades of axes, rubber gloves and other insulating devices on electrical work, goggles and face shields, screens and shields to catch flying chips, etc.

Job safety analysis will furnish the basic information needed for the training procedure. Such an analysis determines the safe methods, brings the hazard points to light, reveals precautions that should be taken, and indicates the specific safeguards that should be used on each operation.

Safety training increases one's effectiveness in enacting the principles of safety education. Safety training must consist of telling, discussing, demonstrating, and providing application under supervision. Fortunately, most individuals can be persuaded quite readily of the value of safety and can work safely with relatively little supervision. One of the most important tasks facing safety-minded administrators, supervisors, and teachers is to discover those individuals who do not respond properly to safety training and why, and either help them to overcome the difficulty or put them to work on inherently low hazard activities. The difficult task of correcting unsafe acts is involved here, as it also is in the problem of accident proneness.

THE INDUSTRIAL TEACHER EDUCATOR CONTRIBUTES TO SAFETY EDUCATION*

Safety education is an integral part of all industrial teacher education. Three of the most important facets or common elements on which the industrial education teacher may build for effective safety instruction include: 1) the "human element;" 2) the content of an effective curriculum; and 3) the auxiliary services available to complement his efforts.

The Human Element in Safety Education

First, the human element refers to people like you and me who, in our present consideration prepare for, enter into, and progress in the occupational matrix of our society. We inherit through birth what psychologists say is our hereditary background. Equally important, we also develop behavior patterns from our environmental background. Thus, heredity and environment play important parts in developing a sound concept and attitude about safety education and industrial hygiene.

Safety education used in its broadest meaning has as its objective the development of a worker who has a proper attitude towards safety and one who develops safe work habits. A program of safety education thus includes all formal and informal techniques of forming attitudes and habits reflected in changed behavior patterns. As the human element, you and I reach maturation in safety education to the degree that our teaching-learning processes are effective.

Planned Teacher Education Programs

This brings us to the second facet of safety education; namely, "a planned program" in teacher education. At this point, my remarks are specific as we deal with that branch of teacher education which prepares candidates to teach in vocational-industrial or vocational-technical education–the shops and laboratories, and the related trade subjects.

Common Elements in Industrial Teacher Education

Throughout this land, teachers of shop work are required to have mastered a trade, and teachers of technical laboratory work or related trade subjects to have secured industrial experience following an engineering or equivalent preparation. So, one of the basic steps in affecting a transition from working in industry to teaching is to have each such person analyze his trade This is called "trade analysis." As a result, the potential teacher identifies all the learning needed by an unskilled student to enter into a skilled trade or technical occupation. In this process of analyzing the skills, the trade theory content, or the related trade subject content, he also identifies safe practices to be followed for each hand tool, portable machine, machine tool, instrument, material, type of construction, and the like for his trade.

---

* This entire section taken from Reference 5.

Articulating Safety Education in the Curriculum

The next step is to select from this reservoir of potential content that core of information which meets very specific objectives. For example, the course may be of pre-employment type or a program of related instruction for apprentice training, or a highly technical course for occupational extension to further improve and expand the craftsman's or technician's work skills. Between these extremes may be the short intensive courses required for retraining. Regardless of the type of course, the assimilation of content for safety education is taught to teachers-in-training through such a professional course as "Course Organization."

At the same time, the potential teacher learns basic principles of psychology and how to apply them in the teaching-learning process. Recognizing that the most important cause of shop accidents lies in the acts of students, the teacher learns about individual differences, and how certain behavior traits, and how even the end results of a teaching situation, either hinder or promote the development of safe work habits.

Another important teacher education course is called "Shop Organization and Management." In this course, the seeds selected from the "trade analysis" and organized in "course organization" take root in the planning for orderly and safe conduct in a learning facility (shop, laboratory, or physical plant for related subjects). All the potentials of the teaching-learning process as identified in psychology, are utilized in the organization and management of a shop or laboratory course.

To move a step further, teacher education programs include such courses as "Materials and Methods," referring to methodology and such curriculum as instruction sheets, outlines, syllabi, and other audio-visual–sensory teaching–learning devices; and in each instance, safety is an integral part of each teaching tool.

A "Rifle Approach" for Industrial Teacher Educators

Now all these common elements, or courses, or experiences in teacher education use the "buckshot approach" to shop safety education. In addition to all these opportunities, more and more industrial teacher education curriculums are including the more specific "rifle approach" through such a course as "Methods of Teaching Shop Safety Education."

Through a series of planned experiences the beginning teacher, or even the teacher with years of experience, may be exposed to leaders from industry, safety, health–in private employ or from governmental agencies–whose knowledge is essential in any effective program of safety education. In quick review such a course in "Methods of Teaching Shop Safety and Hygiene" includes units on:

1. Accidents and accident prevention.

2. Outlining complete safety programs wherein all fundamental psychological drives which motivate human behavior are explored to develop a proper attitude. These attitudes enable a worker to live a normal life without disabling injuries to himself or others or to the equipment or physical plant.

3. Planning proper shop layouts and building services to promote safety education.

4. Maintaining good housekeeping and good upkeep of tools, equipment, and materials.

5. Understanding fire hazards, the prevention of fires, and the use of materials and equipment for fire fighting.

6. Analyzing the needs of an occupational area or shop for personal protective devices.

7. Shop organization and management as related to student activities and an evaluation of safety teaching.

8. Interpreting and preparing guides to safe practices for a particular shop, laboratory, or related subject situation.

9. Analyzing shop jobs for accident hazards and stressing safety precautions within individual instruction:

10. Organizing group instruction for safety topics appropriate to this method. For example, such lessons as the following are best adapted for group instruction:

    a. Reasons for occurrence of accidents.

    b. The industrial accident problem (facts, trends, practices).

    c. Preventing electrical shock or burns.

    d. Personal protective equipment.

    e. Fire prevention.

    f. Occupational health hazards.

    g. First aid (conditions under which it becomes necessary with practices).

    h. Safe environment as a preventive of accidents.

    i. The functioning of safety programs within industry.

11. Accident prevention with problem students.

12. Evaluating safety education.

The final culminating experience in the industrial teacher training program for teaching shop safety should be the development of a guide in which the teacher himself identifies those items of safety and industrial hygiene which are general to all occupational work. Then more specifically, the teacher should plan to teach those standards and codes of behavior which are essential in a specific trade.

Auxiliary Services Available to Industrial Education Teachers

The third facet of the teacher education program relates to utilizing the auxiliary services which are provided by the many organizations actively engaged in promoting industrial safety on the local, state, and national levels. These private and governmental agencies analyze the industrial markets, furnish safety and accident prevention information, publicity, and instructions, and work for the execution of plans and programs. They promulgate safety codes which have the effect of law and then provide for inspection and enforcement of industrial codes. All work with vocational educators toward one goal of conserving manpower by eliminating occupational hazards and by preventing occupational diseases; and when an accident does happen, these supplemental agencies furnish services which minimize human misery and suffering.

Into this picture the National Safety Council also serves industrial educators with its *National Safety News,* its illustrated manual *Safety Education in the School Shop,* its "Congress Transactions," and the many other safety and health practices, pamphlets, safety guides, and valuable, practical materials. These play an important role in every program of safety education.

Summary

In quick review, three major facets of teacher education have been emphasized.

1. Starting with our most priceless possession–our youth and our adults–the human element–we have caught a glimpse of how an effective program in safety education depends on a clear understanding of psychological and social factors as reflected in each individual.

2. We have seen the emergence of safety education from the theory stages of trade analysis, course organization, shop organization and management, and other courses in industrial teacher education into practical instruction in actual teaching through careful articulation based on these learning experiences of teachers.

3. Finally, we have recognized the many important auxiliary services which complement teacher education programs so that in the aggregate "safety conserves manpower–manpower builds the future."

A TEACHER EDUCATION PROGRAM

The foregoing speech was delivered by C. Thomas Olivo, then president of the NAITE (National Association of Industrial Teacher Educators), at the President's Conference on Occupational Safety in Washington, D.C., on March 26, 1958. As the result of Dr. Olivo's presentation and the work of other educators at the conference, the following recommendation was introduced in regard to the school's contribution to occupational safety:

> It is recommended that national organizations and agencies including the American Vocational Association, the National Education Association, the National Safety Council, the American Society of Safety Engineers, and the U.S. Office of Education coordinate their efforts through a steering committee to develop a guide for the organization and implementation of effective school safety programs to be conducted through the cooperation of appropriate agencies at the local level.

The NAITE accepted this recommendation as a mandate that the association assume the leadership for the preparation of a school shop-safety education textbook for use in pre-service and in-service training of industrial arts and trade and industrial shop teachers. In 1960, the association assumed such a leadership and as a result, the *Accident Prevention Manual for Shop Teachers*[6] became a reality as a professional publication of the National Association of Industrial Teacher Educators. Members of the NAITE spent time in research and investigation; they knew what they wanted. They needed a comprehensive text which included planning a safety program, the place of the shop in the total school safety program, the administrator's function, the choice and use of safety devices, safe practices; every aspect of accident prevention, theoretical and practical, must be covered. A proposal of the Association's planning committee spelled out that each area was to be covered by a separate chapter, and that it was to be researched and written by an expert in that area. The completed volume represents years of intensive effort multiplied many times by the practical as well as the teaching experience of recognized experts. The detailed planning and editing was under the direction of a member of the Association who had previously demonstrated a strong interest in accident prevention in school shops. The book is available from the publisher, The American Technical Society of Chicago, Illinois. Royalties from the sale of the publication are paid to the NAITE for use in promoting further teacher training activities. The table of contents of the manual includes the following items:

1. Introduction to accident prevention.

2. Organizing an effective accident prevention program.

3. Developing safety consciousness.

4. Preferred safety practices for school shops.

5. Planning and maintaining a safe environment for shop students.

6. Inspecting for safety in the school shop.

7. Guarding mechanical hazards.

8. Using personal protective equipment.

9. Discovering and eliminating school shop health hazards

10. Shop teacher liability.

11. Recording and reporting accidents.

12. Utilizing national, state, and local agencies.

In addition, the following items are included in the publication:

1. A bibliography.

2. 1960 Threshold Limit Values.

3. Hygienic information guides.

4. Drawings of local ventilation situations.

A study guide for the *Accident Prevention Manual for Shop Teachers*[7] is also available from the American Technical Society for teacher education use. The guide has two major elements for each of the twelve chapters of the manual—1) study assignments, and 2) an examination. The study assignments include two or three "learning progress checks" made up of ten "agree-disagree" statements, which help the students check quickly on what he has learned from the manual and to indicate any material requiring further study. Each question of the progress-checks includes a reference page in the manual so that review can be easily accomplished. The correct answers to the progress-checks are given in the answer key provided in the study guide. The examination for each chapter includes ten essay-type questions and fifteen multiple-choice statements. An answer key for the examinations is made available to teacher educators by the publisher of the study guide.

SAFETY EDUCATION FOR ADMINISTRATORS AND SUPERVISORS

The success of the administration and supervision of an accident prevention program depends upon skill as much as it depends upon knowledge and understanding. Basic instruction in the elements of such a program is aimed at imparting knowledge about safety principles and creating a proper attitude toward accident prevention. To be able to do a good safety job, school administrators and supervisors need education *and* training in organizing the administration, supervision, and implementation of the accident prevention program. Leadership in providing safety education for administrative and supervisory staffs must come from state departments of education. This guide has been prepared to provide necessary professional information for such a program of instruction.

Many methods and techniques of instruction are available for the education and training of administrators and supervisors in accident prevention. Such methods include 1) problem solving conferences, 2) individual instruction and coaching, 3) work projects, 4) conventions, 5) programmed instruction, and 6) reading opportunities.

Problem-Solving Conferences

The problem-solving conference is a particularly effective method whenever a large number of people is involved. The conference method can yield long-range educational benefits for participants, even though its primary purpose is to solve immediate problems. A conference is a discussion in which a leader and a group take part; the leader directs and controls the discussion towards a predetermined goal, with most of the ideas being developed by the group. The functions of a conference leader include the following:[8]

1. The leader states the problem.

2. He encourages free discussion.

3. He breaks down the problem in order to facilitate discussion.

4. He makes sure that all significant points are given adequate consideration.

5. He notes any conclusions that are reached.

6. He states the final conclusion in such a way that it truly represents the findings of the group.

Individual Instruction and Coaching

Often overlooked as a method of safety education is personal discussion with individual administrators or supervisors. When the safety specialist and the educational leader meet to discuss accident prevention, there can result a more complete and open exchange of ideas than is possible in a group situation. In private conference the administrator or supervisor will often express reservations or doubts that he might not voice in a group meeting, thus making it possible for the safety man to clear up misunderstandings. When the safety man meets with individual superintendents or principals, he not only is able to instruct and coach, but is able to learn many things he needs to know as well. Educational leaders appreciate interest in their work and are usually eager to inform others of their particular activities. Every safety specialist should allot a part of his time to such personal contacts.

Work Projects

Probably the best kind of safety training for educational supervisors consists of actually doing a job that needs to be done. Small groups of qualified supervisors working with the safety specialist can contribute toward safety by working on accident prevention. Following is a list of suggested projects:

1. Set up inspection procedures and develop inspection checklists.

2. Develop rule books, safety instruction cards, and job procedures.

3. Make a study of accident costs.

4. Set up and conduct safety contests of various types.

5. Develop safety training aids and exhibits.

6. Plan and conduct programs for educational meetings and for community meetings.

The value of having supervisors undertake such jobs is that they acquire a personal interest in the accident prevention program as well as knowledge and skill.

Conventions

School administrators and supervisors should be given opportunities to attend regional and state safety conferences. The meeting programs and especially the exhibits of safety equipment are instructive. Experienced supervisors and safety specialists often speak at these conventions, and provide demonstrations or exhibits of outstanding safety work. The inclusion of safety programs at conventions of state educational associations should be encouraged by safety education leaders. Many state and local educational agencies send their leaders to the National Safety Congress held annually in Chicago. Its great size, elaborate exhibits, and wide variety of meetings and contacts can make it a valuable experience.

Programmed Instruction

Programmed instruction is a technique used to supplement classroom and textbook methods of safety education and training. Using self-contained teaching materials, programmed instruction permits the student to set his own pace. The learning process is reinforced by the requirement that the student answer questions and correct his errors before progressing with the program of instruction. The National Safety Council offers one type of programmed instruction course for the safety training of industrial supervisors, and such a course could be used as a model for the safety education of administrators and supervisors. Courses available from other sources use self-education techniques for training in such subjects as management skills and communications.

Reading Material

The reading references and the bibliography of this guide provide a comprehensive listing of books, booklets, pamphlets, magazines, periodic articles, and unpublished materials devoted to safety subjects.

SAFETY EDUCATION AND TRAINING OF STUDENTS

Many aspects of school shop and laboratory safety lend themselves to planned group or individual instruction, either incorporated into manipulative instruction or presented separately. The course of study should refer to major topics and should consider desirable methods and techniques of teaching accident prevention, such as:

1. Individual instruction.
   a. Individual demonstration.
   b. Observation and evaluation of individuals.
   c. Safety analysis of each job or operation.
   d. Instructional materials showing safety precautions.
2. Group instruction.
   a. Lesson plans for group lessons.
   b. Plans for group instruction.
   c. Films on safety.
   d. Notebook work to be required.
   e. Field trips.
   f. Group tests on safety.
3. Additional visual aids to be used.
   a. Posters.
   b. Displays.
   c. Bulletins.
   d. Exhibits.

Safety instruction should be presented to students with the following objectives in mind:

1. **Developing in each student a sense of responsibility for his own safety and that of others.** Such an objective can be gained only in an environment of self-discipline characterized by the ability of every student to think for himself. Attitude formation is a difficult task for

any teacher, since it is based on psychological factors, such as individual differences, motivations, and emotions. All of these factors are relevant to accident prevention.

2. **Helping students understand that the effective way of doing things is the safe way.** Development of this understanding requires the services of a teacher who will continually reinforce his teaching with accepted methods and techniques of instruction. An example of such a technique is the use of audio-visual safety aids. Such aids are available on a rental-free basis from industry through film distributing agencies.

3. **Helping students recognize situations involving hazards.** The teacher who applies the principle of "learning by doing" will find the task of accomplishing this objective a rewarding experience. "Doing" activities for students should include: a) analyzing shop jobs for the hazards associated with each operation and then applying a control to each hazard, b) investigating shop accidents and preparing accident reports, c) serving as safety foremen and gaining the experience provided by completing daily report forms.

4. **Helping students learn safe practices for use in meeting their own day-to-day activities.** Industry is showing increased interest in the reduction of off-the-job accidental injuries. The school shop teacher should follow the lead of industry by trying to minimize the number of public and home accidental deaths and making his students more conscious of accident hazards in everyday activities.

Teaching Practices

Teachers will find the following practices effective in the education and training of their shop or laboratory students:[9]

Use information sheets dealing with the general safety rules of the shop. Information sheets should be short, concise, easily understandable, and of a standard size to fit each student's notebook. The sheet is intended as a teaching device to be used during discussions of the general safety rules, and then followed by a short quiz to determine the extent of student learning. This particular sheet should be distributed on the first day that the class reports to the shop area. It should also be posted on the shop bulletin board.

Use information sheets dealing with the safe use of specific hand tools. These sheets are intended to be used prior to or during a demonstration of a specific hand tool. Each demonstration should be followed by a short quiz to determine the extent of student learning.

Use information sheets dealing with the safe operation of hazardous machines. These sheets are intended to be used prior to or during demonstrations of the proper use of a specific hazardous machine. A short quiz should follow to determine the extent of student learning.

Give periodic shop demonstrations on the proper use and care of personal protective devices such as goggles, face shields, hoods, aprons, etc. No personal protective device is effective unless it is functioning properly. The student must be made aware through periodic demonstrations of the proper methods of wearing protective devices and maintaining them in an efficient condition.

Give periodic shop talks emphasizing the importance of each student acquiring the proper attitude towards accident prevention. The shop talk is a short and informal lecture. The shop talk is usually not scheduled but is given as the occasion presents itself. Skilled teachers will employ the discussion in combination with the shop talk. This method of teaching is one of the most effective means of developing safety consciousness.

Conduct field trips to industrial plants or construction jobs to study safety practices. The field trip provides an excellent opportunity for the teacher to provide first-hand information on the safety practices employed by the trades and industries. The trip must be planned well; contact should be made with the safety director of the plant regarding the purposes of the visit. Students must be prepared in advance so that they will know what to observe and how to conduct themselves to avoid interfering with the normal operation of the plant or the construction job.

Provide for visiting speakers from business and industry to speak on occupational safety and health practices. The use of resource people from business and industry to speak to student groups is stimulating and promotes better understanding between the school and the community. It is an especially effective approach in revealing the seriousness of an accident prevention program for shop students. The talk should be followed by a discussion led by the teacher directed toward a clearer understanding of the material presented by the speaker.

Obtain safety literature from the National Safety Council or similar organizations for distribution to students as instructional materials. Commercially produced safety literature can be a valuable means of promoting safety education. However, the teacher must provide an organized plan for study and follow-up. The material must also be carefully screened by the teacher to determine its applicability to the units of the course of study. Some of these materials and their sources are listed in the bibliography of this guide.

Display National Safety Council safety posters in the shop. Safety posters are attention-getters and are valuable as teaching aids because they visually emphasize safety practices. Posters should be periodically rotated to maintain effectiveness. These posters are listed and illustrated in a catalog of the National Safety Council available to shop teachers.

Provide a bulletin board for safety bulletins, safety posters, and safety rules and regulations. The proper use of bulletin boards helps the cause of accident prevention. Boards should be placed where students can readily see them. They should be approximately 22 inches wide by 30 inches long and can be centered at eye level about 63 inches from the floor. They should be attractive and, if possible, glass covered. A bulletin board need not carry safety materials exclusively. In fact, safety notices may have a stronger appeal if they appear on a board which also displays other kinds of material.

Provide a safety suggestion box for student use. Many sound accident prevention ideas can be obtained from students if they have the opportunity to express them. The suggestion box is one means of discovering these ideas. The suggestions should be discussed and evaluated, preferably by the shop safety committee, and plans made for their implementation.

Prepare a written safety education program for the shop. It is not enough for the teacher to merely desire a safe shop—he must plan, organize, and work hard to bring about the safe environment which he is seeking. He must see that safe working conditions and materials are provided, maintained, and safely used. He must make the teaching of safety an integral part of his normal shop instruction. He must plan for pupil participation in the safety program in order to awaken maximum interest and to capitalize on direct pupil experience. The only effective way to set up such a safety program is a written plan or course of study for safety teaching.

Provide for safety instruction integrated into the course of study. Safety instruction must be an integral part of the total structure of the course of study. Safety material that should be considered can be classified into three broad categories: a) topics relating to shop or laboratory routine and to the establishment of a safe and orderly teaching situation; b) safe practices pertaining to the operation of hazardous equipment and the use of hand tools and materials; and c) safe practices that must be observed in the performance of the operations outlined in the course of study. Just as the teacher relies on a trade analysis to find teacher content for a course of study, so should he rely on a job safety analysis of the hazards of a trade to determine accident prevention measures. From a legal point of view, the course of study could supply one form of evidence to support the teacher in the event of a liability suit resulting from classroom injury.

Require all beginning students to make a careful study of hazards in the shop or laboratory area during the first few days of the course. This activity would consist of a student's making a tour of the area, noting the physical hazards, and listing them on an analysis sheet. A discussion session led by the teacher would be devoted to a detailed analysis of each hazard in an effort to answer the question "How will you control the hazard?" or, "How can we prevent possible accidents which might be caused by this hazard?"

REFERENCES

1. U.S. Department of Labor, Bureau of Labor Standards, *Safety Subjects,* Bulletin No. 67, p. 93.

2. *Ibid,* p. 94.

3. *Ibid,* p. 94.

4. *Ibid,* p. 96.

5. C. Thomas Olivio, *The Industrial Teacher Educator Contributes to Safety Education,* a speech presented on March 26, 1958 before the President's Conference on Occupational Safety in Washington, D.C.

6. William A. Williams ed., *Accident Prevention Manual for Shop Teachers,* (Chicago: American Technical Society, 1963).

7. William A. Williams, *A Study Guide for the Accident Prevention Manual for Shop Teachers* (Chicago: American Technical Society, 1966).

8. National Safety Council, *Accident Prevention Manual for Industrial Operations,* 5th ed., 1964, National Safety Council, p. 6-13.

9. Williams ed., *op. cit.* pp. 94-101.

BIBLIOGRAPHY

BIBLIOGRAPHY

BOOKS

American National Red Cross. *First Aid.* 4th ed., Garden City, New York: Doubleday and Co., Inc. 1957. 241 p.

Association of Casualty and Surety Companies, Accident Prevention Department. *Education for Safety Through the School Shop,* 1952. 109 p. 110 William Street, New York 10038.

______.*Handbook of Industrial Safety Standards,* 9th ed., 1954. 315 p.

Associated General Contractors of America. *Manual of Accident Prevention in Construction,* 5th ed., 1957 East Street, N.W., Washington, D.C.: Associated General Contractors of America, Inc. 1958.

Blake, R. P. and others. *Industrial Safety,* 3rd ed., New York: Prentice Hall, Inc., 1963, 405 p.

DeReamer, R. *Modern Safety Practices,* New York: John Wiley and Sons, Inc., 1958. 357 p.

Fawcett, Howard H. and Wood William S. *Safety and Accident Prevention in Chemical Operations,* New York: John Wiley and Son., Inc., 1965. 617 p.

Florio, A. E. and Stafford, G. T. *Safety Education,* 2nd ed., New York: McGraw-Hill Company, Inc., 1962. 382 p.

Hannaford, Earle S. *Supervisors Guide to Human Relations,* Chicago: National Safety Council, 1967. 352 p.

Heinrich, H. W. and others. *Industrial Accident Prevention – A Scientific Approach,* 4th ed., New York: McGraw-Hill Book Co., 1959. 480 p.

Kigin, Denis J. *Teacher Liability in School Shop Accidents,* Ann Arbor, Michigan: Prakken Publications, Inc., 1963. 128 p.

Larson, J. C. and others. *The Human Element in Industrial Accident Prevention,* New York: New York University Center for Safety Education, 1955. 112 p.

McFarlane, D. I. *Safety in Industry: An Introduction to the Protection of Personnel,* 15 East 40th Street, New York 10016: Philosophical Library, 1955. 71 p.

National Education Association. *Who is Liable for Pupil Injuries?* Washington, D.C., Research Division, 1963. 72 p.

______ *The Teacher and the Law,* 1959.

National Fire Protection Association. *Fire Protection Handbook,* 60 Batterymarch St., Boston, Mass. 02110, 1965. 2,216 p.

______*National Fire Codes.* 1967-1968. (Published in 10 volumes.)

National Safety Council. *Accident Prevention Manual,* 5th ed., 1964. Chicago. 1,424 p.

______*Forging Safety Manual,* 1965. 86 p.

______*Fundamentals of Industrial Hygiene,* 1968. 120 p.

______*Handbook of Accident Prevention,* 1965. 98 p.

______*Power Press Safety Manual,* 1958.

______*Safety Guide for Unions,* 1962. 225 p.

______*Safety Handbook for Office Supervisors,* 1961. 56 p.

______*Safety Manual for Graphic Arts Industry,* 1953. 96 p.

______*Supervisors Safety Manual,* 3rd ed., 1968. 352 p.

Remmlein, Madaline K. *School Law,* New York: McGraw-Hill Book Company, Inc., 1950.

Simonds, R. H. and Grimald, J. V. *Safety Management:* Accident Cost Control, Homewood, Illinois: Richard D. Irwin, Inc., 1963. 597 p.

Stack, H. J. and Elkow, J. D. *Education for Safe Living,* 3rd ed., Englewood Cliffs, N.J.: Prentice-Hall Publishing Co., 1957. 364 p.

Strasser, Marland K. and others. *Fundamentals of Safety Education,* New York: Macmillan Company, 1964. 453 p.

University of Texas, *Handbook for Shop Teachers,* 3rd ed., Austin, Texas: Division of Extension, 1959. 127 p.

Williams, William A. *Accident Prevention Manual for Shop Teachers,* Chicago: American Technical Society, 1963. 550 p.

PAMPHLETS, BOOKLETS, MAGAZINES

Air Reduction Co. *Safety Starts Here, Think. Recommended Safe Practices in Cutting and Welding,* 150 East 42nd Street, New York: The Company. 1954. 32 p.

Aluminum Company of America. *Alcoa Mobile Works Safety Rules,* Alcoa Building, Pittsburgh, Pa. 15219: The Company. 1964. 28 p.

______.*Electrical Safety Rules,* 18 p.

______.*Getting Acquainted with Tennessee Operations,* 1965. 31 p.

______.*Safety Pays.*

American Insurance Association, Engineering and Safety Dept., *General Safety Instruction,* 1965. 21 p., 85 John St [illegible]w York 10038.

______.*Safe Use and Care of Hand Tools,* Engineering and Safety Department. 1965. 29 p.

______.*Your Guide to Safety from Electrical Hazards,* 1961. 19 p.

______.*Your Guide to Safety in the Machine Shop,* 1965. 32 p.

______.*Your Guide to Safety in Welding and Cutting Operations,* The Association, 1962. 30 p.

______.*Your Guide to Safety in Woodworking Shops,* 1963. 27 p.

American Optical Company. *Personal Protective Equipment for Schools and Colleges,* Southbridge, Massachusetts: Safety Products Division, 1965. 9 p.

American Society of Safety Engineers, *Engineering for Safety* (Monthly), 5 North Wabash Avenue, Chicago 60602.

______.*Human Factors Research in Occupational Accident Prevention,* Chicago: The Society and The Center for Safety Education, New York University, Reprinted 1964. 44 p.

American Welding Society. *Lens Shade Selector,* A 62-61. 345 East 47th Street, New York 10017: American Welding Society. 1961.

______.*Recommended Safe Practices for Gas-Shielded Arc Welding,* A 6.1-66.

______.*Safe Practices for Welding and Cutting Containers that Hold Combustibles,* A 6.0-65.

______.*Safety in Electric and Gas Welding and Cutting Operations,* American Standard Z 49.1-50, 1950.

______ *Safety in Welding and Cutting,* American Standard Z 49.1, 1958.

Appleton Vocational and Adult Education School, *Safety Handbook for Shop Teachers,* Appleton, Wisconsin: Appleton Vocational and Adult Education School, 1962. 38 p.

Bottineau FFA Chapter. *Farm Safety Handbook for Future Farmers,* Bottineau, N.C.: FFA Chapter, 1957. 30 p.

California State Department of Education. *Industrial Arts Safety Instruction,* by Woodward, Robert L., Sacramento, California: 1966. 64 p.

Chicago Public School. *Emergency Care: Flip Chart,* 228 North LaSalle Street, Chicago: Chicago Board of Education. 1959. 24 p.

Colorado Agriculture and Mechanical College. *Safety Practices in Farm Mechanics,* Fort Collins, Colorado: Colorado A and M College. 1956. 42 p.

Connecticut State Department of Education. *A Safety Checklist for School Shops,* Bulletin No. 75. Hartford, Connecticut: Connecticut State Department of Education. 1955. 12 p.

Detroit Free Public Schools. *Handbook of Safety Regulations,* Publication 205. Detroit: Board of Education. 1956. Approx. 185 p.

______. *Manual for Welding Teachers,* by Althouse, A. D., 1950. 71 p.

______, *Safety Tests – Handbook for Students in Senior High, Technical and Trade Schools,* 1962. 164 p.

Electric Storage Battery Company. *Battery Service Manual.* 2000 The East Ohio Building, Cleveland, Ohio 44101: Automotive Division. 1964. 38 p.

Fendall Company. *How to Install a School Eye Protection Program,* 1965. 12 p. 2222 Diversey Parkway, Chicago 60647.

______. *Catalog,* 1963. 32 p.

______. *School Eye Protection Guide,* 1965. 8 p.

Future Farmers of America. *At Work for Safety: Handbook for Teachers of Vocational Agriculture.* FFA. Washington, D.C.: Future Farmers of America, U.S. Office of Education, 1955. 18 p.

General Electric Company. *School Lighting,* T. P. – 102. 20800 Center Ridge Road, Cleveland, Ohio 44116: General Electric Company. 15 p.

General Motors Corporation. *ABC's of Hand Tools.* Technical Center, Warren, Michigan 48090: Public Relations Staff, 1945. 45 p.

Hagar, C. N. and Tammeryn, J. *Specific Facts of School Safety.* Tampa, Florida, Florida Association of Insurance Agents. 1959. 19 p.

Hannaford, Earle S. *Industrial Safety Attitude Scales for Male Employees and Male Supervisors.* New York: The Center for Safety Education, New York University. 1959.

Hawaii State Department of Education. *Safety Manual for Agriculture Education,* by Horrii, T. and Paulas, L. G., Honolulu: Division of Vocational Education, 1959.

Hogan, Howard K. *School Shop Safety Bibliography.* Multilithed. Washington, D.C.: U.S. Department of Health, Education and Welfare, Office of Education, 1960. 23 p.

Illinois State Board of Vocational Education. *Making the School Shop a Safe Place to Work: A Practical Approach to Shop Safety,* 1952. 15 p., Springfield.

Illuminating Engineering Society. *School Lighting Application Data.* 345 East 47th Street, New York City: 16 p.

The Industrial Commission of Ohio. *Monitor.* Monthly. 700 West Third Avenue, Columbus, Ohio 43212: Division of Safety and Hygiene.

Kigin, Denis J. *Tort Liability Affecting Shop Teachers with Provisions for Avoiding Accidents and Litigation:* Summary of Dissertation Study. Education Series No. 74. Columbus, Mo.: The University of Missouri Bulletin, January 1960. 21 p.

Linde Company. *Precautions and Safe Practices in Welding and Cutting with Oxy-Acetylene Equipment.* 270 Park Avenue, New York: Linde Company, Division of Union Carbide Corporation, 1957. 58 p.

______. *Safe Practices for Handling Compressed Gasses,* 1957. 4 p.

Los Angeles City Schools. *Handbook of Safety Regulation.* Los Angeles, California: Los Angeles City School District, 1959. 155 p.

______. *Safety Manual for Industrial Education Teachers.* Publication No. SC-601, 1964. 145 p.

______. *Safety Rules and Regulations for the Trade.* Los Angeles, California: Division of the Instructional Services. 1966. 74 p.

Metropolitan Life Insurance Company. *Accident Prevention Can Be Learned,* 1962. 40 p. 1 Madison Avenue, New York: School Health Bureau.

Michigan State Board of Control for Vocational Education. *Training for Safety–A Program for Shop Teachers.* Bulletin No. 279. 1942. 155 p. Lansing, Michigan.

National Association of Mutual Casualty Companies. *Safe Openings for Some Point of Operation Guards,* 1949. 16 p. 20 North Wacker Drive, Chicago.

______. *Spreaders of Variety and Universal Saw,* 1948. 16 p.

______. *Woodworking Circular Saws – Protection for Variety and Universal Types,* 1950, 30 p.

National Commission on Safety Education. *Accident Research for Better Safety Teaching.* 1201 Sixteenth Street, N.W., Washington, D.C.: 1964. 32 p.

______. *Checklist of Safety and Safety Education in Your School.* Washington, D.C.: The Commission, National Education Association. 1963 revision. 47 p.

______. *Fire Safety for Senior High Schools,* 1951. 31 p.

______. *The High School Principal and Safety,* 1948. 31 p.

______. *Safe Use of Electrical Equipment,* 1951. 35 p.

______. *Safety.* Bi-monthly magazine. National Education Association.

______. *Safety in Farm Mechanics and with Farm Machines.* (Rural series No. 2) 1948. 31 p.

______. *Who is Liable for Pupil Injuries,* 1963. 70 p.

National Fire Protection Association. *Cutting and Welding Processes,* No. 51B. 1962. 8 p., Batterymarch St., Boston, Mass. 02110.

______. *Fire Hazard Properties of Flammable Liquids, Gases and Solids,* 1965. 44 p.

______. *Fire Hazard Study: Flammable Liquids in Garages,* HS-2. 1961, 20 p.

______. *Flammable and Combustible Liquids Code,* No. 30. 1964. 216 p.

______. *Flash Point Index of Trade Name Liquids,* No. 325A. 1964. 216 p.

______. *Hazardous Chemicals Data,* 1965. 175 p.

______. *Manual of Hazardous Chemical Reactions,* No. 491M. 1964. 108 p.

______. *National Electrical Code,* No. 70. 1965. 433 p.

______. *Occupancy Fire Record: Laboratories,* 1958. 16 p.

______. *Occupancy Fire Record: Public Schools,* 1957. 24 p.

______. *Recommended Good Practice for the Installation, Maintenance, and Use of Portable Fire Extinguishers,* No. 10. 1965. 70 p.

______. *School Fires, Historical Record,* 1946. 50 p.

______. *Special Hazard Study: Welding and Cutting in Garages,* HS-1. 1961. 12 p.

______. *Standard for the Installation and Operation of Oxygen-Fuel Gas Systems for Welding and Cutting,* 1964. 32 p.

______. *Standard for Spray Finishing,* No. 33. 1963. 44 p.

National Safety Council. *Accident Facts* (issued annually in July), 425 North Michigan Avenue, Chicago 60611: 96 p.

______. *Catalog/Poster Directory,* (issued every 18 months).

______. *Farm Safety,* (bi-monthly)

______. *Industrial Data Sheets,* (revised as required.) (Selected.)
"Abrasives, Coated," No. 452
"Accident Records and Analysis, Work," No. 527
"Accident Records, Off-the-Job," No. 601
"Acetylene," No. 494
"Air-Powered Hand Tools," No. 392
"Airless Spray Painting," No. 548
"Alligator Shears," No. 213
"Automotive Hoisting Equipment," No. 437
"Blowtorches and Plumbers' Furnaces," No. 470
"Boring Mills, Horizontal Metal," No. 269
"Boring Mills, Vertical Metal," No. 347
"Chemical Safety References," No. 486
"Cleaning Machinery and Electric Motors," No. 285
"Color in Industry," No. 219
"Drill Presses, Metal-Working," No. 335
"Electric Cords and Fittings," No. 385
"Electric Equipment Grounding–Portable," No. 299
"Floors, Slippery," No. 286
"Jointers, Wood," No. 280
"Lathes, Engine," No. 264
"Milling Machines, Metal-Working," No. 364
"Planers, Metal," No. 383
"Planers, Wood, Power Feed," No. 225
"Safety Policies, Occupational," No. 585
"Safety Rules, Industrial," No. 535
"Saws, Electric Hand," No. 344.
"Saws, Metal (Cold Working," No. 584
"Saws, Overhead Swing Cutoff," No. 277
"Saws, Tilting Table," No. 605
"Saws, Woodworking Band," No. 235
"Shapers, Metal," No. 216
"Shapers, Wood," No. 333
"Shears, Squaring, Metal," No. 328

______. *Industrial Supervisor,* (monthly).

______. *Men and Motives in Safety Supervision,* (Set of six pamphlets.)

______. *National Safety News,* (monthly).

______. *Safe Worker,* (monthly), 16 p.

______. *Safety Education Data Sheets,* (selected).
"Amateur Electricians, Safety For," No. 78
"Auto Shop, Safety in the," No. 57
"Chemistry Laboratory, Safety in the," No. 59
"Drafting Room, Safety in the," No. 95
"Electrical Shop, Safety in the," No. 87
"Farm Mechanics Shop, Safety in the," No. 60
"General Metals Shop, Safety in the," No. 50
"Glassware, Laboratory," No. 23
"Graphic Arts Shop, Safety in the," No. 64
"Industrial and Vocational Education Programs, Coordinating safety in," No. 79
"Machine Shop, Safety In the," No. 53
"Office Safety," No. 82
"Sheet Metal Shop, Safety in the," No. 83
"Welding and Cutting Safety," No. 56
"Woodshop, Safety in the" No. 46

______. *Safety Education Reprints* (selected).
"Changes Bring New Needs in Home Economics Classes," No. 149
"Curriculum Planning for Safety," No. 40
"Guilty (Legal Liability)," No. 176
"Help (Administrative Guidance)," No. 195
"How Teachers Get Hurt," No. 177
"A Job Analysis for Safety Education Supervisors," No. 141
"Legal Liability and Accident Costs," No. 120
"The Negligent Teacher," No. 193
"Recommended Standards for Administration," No. 47
"Safety Eyewear," No. 192
"Teaching Safety to Teachers," No. 163
"Who Pays for Shop Accidents?" No. 168
"Who's Liable?" No. 158

______. *School Shop Safety Inspection Checklist,* 4 p.

______. *Student Accident Reporting Materials Guidebook,*

______. *Traffic Safety,* (monthly)

National Society for the Prevention of Blindness. *Eye Safety in the School Shop Program,* by Hopping, Spender B. Publication No. 124. 16 East 40th Street, New York 10016, 8 p.

______. *Vision and Vocational Training,* by O'Neill, James E. Publication 244, New York, 1956. 4 p.

New Hampshire State Board of Education. *Safety Handbook for School Shops,* Institute Circular No. 771. Concord, N.H.: The State Board. 1945. 56 p.

New York City Board of Education. *School Shop Safety Manual.* Curriculum Bulletin No. 13. 130 West 55th Street, New York 10019: The Board, 1965. 164 p.

______. *The Administration of Safety in the New York City Schools,* 1958-59. 279 p.

New York University, Center for Safety Education. *Basic Aspects and Applications of the Psychology of Safety,* by Dunbar, F. and Brody, L. 130 West 55th Street, New York 10019: 1959, 24 p.

______. *Human Factors Research in Occupational Accident Prevention,* by Brody, Leon, 1962. 44 p.

Ohio State University. *Instructional Materials for Trade, Industrial and Technical Occupations.* Columbus, Ohio: Trade and Industrial Educational Materials Laboratory. Revised 1964. 42 p.

Oklahoma State Department of Education. *Accident Prevention in Oklahoma School Shops,* Oklahoma City, Okla: The State Department. 1944. 42 p.

Pennsylvania Department of Public Instruction. *Fire Protection in Schools.* Bulletin No. 399. Harrisburg, Pa.: 1951. 180 p.

Pittsburgh Public Schools. *Vocational Education in the Pittsburgh Public Schools.* Pittsburgh, Pa. 1963. 76 p.

Quam, G. H. *Safety Practice for Chemical Laboratories.* Villanova, Pa.: 1963. 78 p.

Rochester City School District. *Safety Regulations for Vocational Shops.* Rochester, N.Y.: Rochester School District. 119 p.

Rural Electrification Administration. *Suggestions for Your Safety Program.* REA Bulletin 168-10, Washington, D.C.: U.S. Department of Agriculture, 1959. 7 p.

San Francisco Unified School District. *Safety Guide for Shop Teachers.* 135 Van Ness Avenue, San Francisco, California: San Francisco Public Schools. 1956. 130 p.

______. *Safety in the School.* 1954. 150 p.

Schulzinger, M. S. *The Accident Syndrom.* Springfield, Ill.: C.C. Thomas Company. 1956. 26 p.

Stanford Research Institute. *Trial Presentations of a Nuclear Energy Training Course in Two Adult Vocational Education Programs.* SRI Project No. IU-2862. Washington, D.C.: U.S. Atomic Energy Commission, October 1959. 101 p.

Texas A & M University. *Organizing and Teaching Accident Prevention Subjects.* College Station, Texas 77843: Texas A&M University. 70 p.

U.S. Atomic Energy Commission. *Living with Radiation:* In Fundamentals. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, 1954.

U.S. Department of Army. *Finding and Eliminating Accident Causes.* Civilian Personnel Pamphlet No. 41-B-32. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, 1954.

_____. *Safety on the Job.* Civilian Personnel Pamphlet No. 41-B-81. 1954.

U.S. Department of Health, Education, and Welfare, Office of Education. *Guide for Improving Safety Education Programs in School Shops,* by Hogan, Howard K., Washington, D.C.: Government Printing Office. 1960. Revised 1965. 52 p. (OE No. 84004)

_____. *Research in Industrial Education: Summaries of Studies, 1930-1955.* Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office. (Vocational Division Bulletin No. 264, Trade and Industrial Series No. 65)

_____. *School Shop Safety – A Report of a National Conference,* April 16-18, 1959. Washington, D.C.: Office of Education, 1960. 61 p. (OE No. 84003; Circular No. 609)

_____. U.S. Department of Labor. *Safety in Your Future.* Washington, D.C.: Superintendent of Documents. U.S. Government Printing Office. 1966. 24 p.

_____. U.S. Department of Labor. *School Shop–Learn Safe Work Habits Here.* A Safety Guide for Pre-Employment Training. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office. 1955. 15 p.

_____. *Curriculum Materials for Trade and Industrial Education,* by Strong, M.E., Washington, D.C.: U.S. Government Printing Office. 1963. 76 p. (No. F.S. 5.284:84023A)

_____. *Safety in your Future.* Washington, D.C.: U.S. Government Printing Office. 1955 (Revised 1966) .

U.S. Department of Labor, Bureau of Labor Standards. *Chemistry for the Safety Man,* Bulletin 222. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office. 1960. 26 p.

_____. *Consultative Approach to Safety,* Bulletin 223. 1960. 9 p.

_____. *Control of Electrical Shock Hazards,* Bulletin 216. 1960. 15 p.

______. *Control of the Physical Environment.* Bulletin 211. 1960. 13 p.

______. *Controlling Noise Hazards.* Bulletin 207. 1959. 8 p.

______. *Fire Protection for the Safety Man,* Bulletin 232. 1961. 25 p.

______. *Fundamentals of Accident Prevention,* Bulletin247. 1962. 14 p.

______. *Index of Occupational Health and Safety. Laws, Codes, Rules, and Regulations.* By state and by subject. Washington, D.C.: U.S. Department of Labor, 1958.

______. *Maintenance and Safety,* Bulletin 246. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, 1962. 15 p.

______. *Mechanical Handling of Materials,* Bulletin 219. 1960. 29 p.

______. *Mechanics for the Safety Man,* Bulletin 239. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office. 1962. 24 p.

______. *Personal Protective Equipment,* Bulletin 231. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office. 1961. 26 p.

______. *The President's Conference on Industrial Safety–Reports of the Committee on Education.* 1949-50. Bulletin No. 132. 1950. 67 p.

______. *The President's Conference on Occupational Safety Proceedings,* Bulletin 196. 1958. 210 p.

______. *Principles and Techniques of Mechanical Guarding.* Bulletin No. 197. 1959. 58 p.

______. *Report of Work Injuries to Minors Under 18 Years of Age,* Bulletin 282. Washington, D.C.: U.S. Department of Labor. 1966. 25 p.

______. *Respiratory Protective Equipment,* Bulletin 226. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office. 1961. 34 p.

______. *Safe Handling of Radioactive Material.* Washington, D.C.: U.S. Government Printing Office. 1964. 107 p. (No. C 13.11:92)

______. *Safe Work Guide for Electricians: Construction Industry.* Washington, D.C.: U.S. Department of Labor. 4 p.

______. *Safe Work Guide for Masons and Tenders: Construction Industry.* 4 p.

______. *Safe Work Guide for Roofers and Waterproofers: Construction Industy.* 4 p.

______. *Safety Guide for Construction Supervisors.* 4 p.

______. *Safety Standards.* (Bi-monthly) Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office.

______. *Safety Subjects: Training Courses for State Factory Inspectors.* Bulletin No. 67. 1956. 280 p.

______. *Selected Publications of the Bureau of Labor Standards.* 1959. 20 p.

______. *Woodworking: Circular Saw Accidents.* Bulletin No. 1190. 1956. 68 p.

U.S. Department of Labor. *A How-to-Lift Model–Build and Demonstrate this Safety Salesman.* Washington, D.C. 20210: Bureau of Labor Standards. 1963. 6 p.

______. *Safety in your Future.* Washington, D.C. 20210: Bureau of Labor Standards and U.S. Office of Education. 1966. 26 p.

U.S. International Cooperation Administration. *Industrial Safety–Hygiene–Fire Prevention: Bibliography.* Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office. 1960.

United States of American Standards Institute, *Safety Standards* (Selected), 10 East 40th Street, New York 10016.

"Abrasive Wheels," B 7.1
"Accident Causes, Recording," Z 16.2
"Accident Prevention Signs," Z 35.1
"Appliances, Installation of Gas," Z 21.30
"Automobiles, Inspection," D.7
"Bakery Equipment," Z 50.1
"Blower Systems," Z 33.1
"Carbon Dioxide Extinguishing Systems," A 54.1
"Clothing, Protective Occupational," L 18
"Color Code for Marking Physical Hazards," Z 53.1
"Compressed Air Machinery and Equipment," B 19
"Compressed Gas Cylinder," B 57 (connections); Z 48.1 (marking)
"Dust Control, Explosions, and Ignitions," Z 12 (series)
"Electrical Code, National," C 1
"Electrical Devices and Materials," C 33 (series)
"Electrical Safety Code, National," C 2
"Exhaust Systems," Z 9.2 (design); Z 33.1 (installation)
"Fire Extinguishers, Portable," Z 112.1
"Flameproof Enclosures of Electrical Apparatus," IEC 79
"Footwear, Protective Occupational," Z 41
"Fuse Links, Cartridges," CEE 4; IEC 127 (miniature fuses)
"Fuse Holders," C33.10
"Fuses," CEE 16
"Gas Containers or Cylinders–
Marking of Compressed," Z 48.1; ISO R 448

  - Valve Connections," B 57
- "Gas-Mask Canisters," K 13.1
- "Graphic Arts Equipment," B 65
- "Grounding and Bonding Equipment," C 33.8
- "Head, Eye, and Lung Protection," Z 2.1
- "Injury Experience, Recording and Measuring," Z 16.1
- "Jacks," B 30.1
- "Ladders," A 14 (series)
- "Laundry, Machinery and Operations," Z 8.1
- "Lighting–
  - Industrial," A 11.1
  - Protective," A 85.1
  - Schools," A 23.1
- "Piping–
  - Gas, Installation," Z 21.30
  - Identification Systems," A 13.1
  - Pressure," B 31 (series)
- "Presses–
  - Graphic Arts," B 65.1
  - Power," B 11.1
- "Protective Equipment for Electrical Workers," J 6 (series)
- "Railings and Toe Boards," A 12
- "Recording and Measuring Accidents," Z 16 (series)
- "Refrigeration, Mechanical," B 9.1
- "Shoes, Safety," Z 41
- "Spray Finishing Operations," Z 9.3
- "Switches," C 33.29 (snap); CEE 14 (domestic)
- "Tools-Portable, Motor-Operated," CEE 20
- "Toxic Dusts and Gases, Acceptable Concentrations," Z 37.12
- "Transformers," C 33.4 (specialty); CEE 15 (isolating)
- "Transmission, Mechanical Power," B 15.1
- "Welding–Electric," C 33.2, C 87.1, C 42.50, Z 49.1
- "Woodworking Machinery," O 1.1
- "Welding–
  - Electric," C 33.2, C 98.1, C 42.50, Z 49.1
- "Woodworking Machinery," O 1.1
  - Gas," Z 49.1
  - Resistance," C 88.1

The University of Texas. *Safety Topics: Guides for Conference Leadership.* Second edition. Austin, Tex.: Division of Extension, Trade, and Industrial Education Department, 1953. 23 p.

PERIODICAL ARTICLES

Albright, Paul. "Safety First Rules Prevent Accidents." *Industrial Arts,* XIX (October 1930) 377-78.

Barocci, Louis. "Safety in the Auto Mechanics Shop." *Industrial Arts and Vocational Education,* XXXIX (September 1950) 39-40.

______. "Safety in the Sheet Metal Shop." *Industrial Arts and Vocational Education,* XL (October 1951). 36.

Bauersfeld, Albert G. "General Safety Rules." *Industrial Arts and Vocational Education,* XX (September 1931) 332.

Baysinger, G. "School Shop Safety in the Teacher Education Program." *Industrial Arts and Vocational Education,* XXXVIII (January 1949) 5,8.

Beavers, Clarence. "Eye Protection Program in College Industrial Shops." *Safety Education,* XXXVIII (April 1959) 37.

Bedell, Earl L. and Peacock, George. "Safety Education in School Shops." *Industrial Arts,* XVIII (September 1929) 334-38.

Bell, Richard. "Safety and Shop Teachers." *Industrial Arts and Vocational Education,* XXXI (March 1942) 32-41.

Bennett, Charles A. "If Negligence is Established, Damages Can Be Collected." *Industrial Arts,* XXIV (March 1923) 264.

Biles, Fred C. "Preventing Accidents in the School Shop." *Industrial Education,* XXXIII (March 1932) 238-40.

Billings, Curtis, "Making the Shop Safe." *Industrial Arts and Vocational Education,* XXII (December 1933) 377-79.

Blumenthal, M. "Scare Techniques." *Safety Education,* XLI (November 1961) 10, 12.

Bohn, L. R. "Safety in the Graphic Arts Shop." *School Shop,* XXIV (February 1965) 31, 3.

Bolmeier, E. C. "Tort Liability of School Personnel." *American School Board Journal* CXXXVI (March 1958) 30, 2.

Bowne, Frank (Jr.). "Negligence-Foreseeability as Limitation on Liability." *Michigan Law Review* (January 1952);

Bruehl, John T. (Jr.). "Safety Rules." *Industrial Arts and Vocational Education,* XLIX (January 1960) 25.

Burnham, Harry A. "Shop Safety Programs in the Flint Schools." *School Shop,* I (May 1942) 7.

Cain, Thomas J., (Jr.). "Personal Protection Pays Off." *National Safety News,* XXCV (March 1962) 136.

Campbell, Edward A. "Built-In Safety for Industrial Education Facilities." *Industrial Arts and Vocational Education,* L (March 1961) 47, 52.

______. "Guide to Personal Protection Devices." *American School Boards Journal,* CXLIX (December 1964) 26-8.

Carroll, George H. and Westerhouse, Alvin W. "Safety Rules and a Pass Card." *Industrial Arts and Vocational Education,* XXVI (November 1937) 388.

Chatfield, William D. "Avoid Accidents–Teach Shop Safety." *School Shop,* X (October 1950) 32.

Cook, G. C. "Safety in the School Shop." *School Shop,* I (January 1942) 3-5.

Crussell, E. H. "Safety First–Common Sense a Poor Second." *Industrial Arts,* X (December 1921) 469-71.

______. "Safety Rules." *Industrial Arts and Vocational Education,* XXVII (October 1938) 348.

Deterline, W. A. "Can Safety Education Be Programmed Successfully." *National Safety News,* XCI (January 1966) 37.

Diamond, T. "Safety in the School Shop." *School Sh[illegible]* XI (April 1952) 6.

______. "Teacher Liability–A Need for Relief." *School Shop,* XI (April 1952) 2.

______. "Youth–And Safety." *School Shop,* XI (April 1952) 52-53.

Dick, Arthur A. "Safe Work Habits." *School Shop,* XIV (December 1955) 11.

Dowden, Alfred L. "Handling Electricity–No Kid-Glove Job." *National Safety News,* XXCIV (December 1961) 28.

Dunne, John B. "What Every New Worker Should Know About Safety." *Industrial Arts and Vocational Education.* XXXIII (October 1944) 318.

Ericson, Emanual E. "Legal Liabilities for Shop Accidents." *Industrial Education,* XXXVI (September 1933) 47.

______. "School Shop Accidents and Their Prevention." *Manual Training,* XXIII (January 1922) 223-28.

Faulkner, LeRoy A. "Industry Wants School Shop Safety Training." *School Shop,* XI (April 1952) 10.

Fawcett, Howard H. "Respiratory Protection." *National Safety News,* XXCVII (March 1963) 94, 96.

Garish, C. E. "Personal Health and Safety in the Shop." *Industrial Arts and Vocational Education,* XLVIII (April 1959) 138+.

Gausman, Chester A. "Legal Aspects of Shop Accidents." *Industrial Arts and Vocational Education,* XLIV (September 1955).

Geiger, L. "Shop Safety Posters." *Industrial Arts and Vocational Education,* XLVII (May 1958) 172.

Genevro, G. W. "Oxyacetylene Welding and Fire." *School Shop,* XXIV (February 1965) 42-3.

Glenn, Harold T. "A Safety Committee for Your Shop." *School Shop,* XVII (October 1957) 60.

______. "Teaching Safe Work Habits." *School Shop,* XVI (January 1957) 11.

Greenwood, Donald B. "Are You in the Doghouse?" *School Shop,* VI (December 1946) 8-9, 14.

Grinstead, Neal B. "Building A Safety Concept." *Industrial Arts and Vocational Education,* XXVI (December 1936) 12.

Grosvenor, C. Rust. "Can Programmed Instruction Change Attitudes." *National Safety News,* XCIII (January 1966) 33-34.

Grove, J. F. "Safety Precautions in the Millroom" *Industrial Arts and Vocational Education,* XXV (December 1936) 375-77.

Gurske, P. E. "Safety in Apprenticeship Training Program." *Qualified Contractor National Electric Contractors Association* (July 1956) 89-91.

Hall, Samuel F. "Safety in the School Shops." *Industrial Arts and Vocational Education,* XXXIII (October 1944) 125-26.

Hamel, A. V. "Non-skid Flooring." *School Shop,* III (April 1944) 15.

Hannaford, Earl S. "Industry Challenges Schools." *Safety Education,* XL (January 1961) 12-13.

______. "Good Safety Attitudes and How to Develop Them." *National Safety News,* LXXIX (June 1959) 22-23+.

______. "Tension and How to Live with It." *National Safety News,* LXXXI (January 1960) 18-19+.

Henig, Max S. "Intelligence and Shop Accidents." *Industrial Arts,* XVII (August 1928) 265-66.

______. "Mental States Other Than Intelligence That Cause Work Accidents." *Industrial Arts and Vocational Education,* XX (January 1931) 7-9.

______. "The Place of the Vocational School in Accident Prevention." *Industrial Arts,* XI (November 1922) 431-33.

Hentzell, C. S. "Safety in the Woodworking Shop." *Industrial Arts,* XVII (March 1928) 94.

Hering, Robert P. "Seven Principles of Employee Motivation." *National Safety News,* XCII (September 1965) 30-31.

Hitlebrandt, H. F. "A Look at Shop Safety Education." *School Shop,* IV (May 1945) 5-6, 30.

Hogan, H. K. "Using School Shops to Develop Safety Consciousness in Tomorrow's Workers." *School Life,* XLI (May 1959) 12-15.

Hopkins, S. K. "Standards for Safety Eye Wear." *National Safety News,* XCII (October 1965) 29.

Hughes, Wayne P. "Eye Protection Legislation." *School Shop* XXVI (February 1966).

______. "Plan for Safety in Purchasing." *School Shop,* IX (April 1950) 8-9.

______. "Safety Factors in Shop Planning." *School Shop,* VIII (April 1949) 7-8.

______. "Score Sheet on School Shop–After Two President's Conference." *Safety Education,* XXXVIII (November 1958) 25.

Hughes, Wayne P. and Hopkins, Stuart, "Don't Gamble on Eye Protection." *Industrial Arts and Vocational Education,* LXIII (December 1963) 34.

Hughes, Wayne P. and Williams, William A. "Safety and Health Needs for Equipping School Shops." *School Shop,* XX (April 1961) 24-26.

Humble, M. Keith. "Safeguarding Shop Students." *Education,* LX (May 1940) 574-78.

Hunt, DeWitt. "Minimum Safety Guards." *School Shop,* V (January 1964) 9.

Irons, G. E. "Guarding the Machinery in the School Shops." *Industrial Arts,* XVI (March, April, 1927) 106-07, 155-57.

Jones, H. B. "No School Shop is Ever Safe." *School Shop,* VII (June 1948) 8.

Johnson, I. H. "Safety in the Electrical Shop." *Safety Education,* XXXVII (April 1958) 23-5.

Judy, Wayne M. "Accidents and Safety Education." *Industrial Arts and Vocational Education,* XXII (September 1933) 267-69.

Kamperman, George W. "Noise Control." *National Safety News,* XXCVII (March 1963) 84.

Karch, R. Randolph "Accidents and the Printer." *Industrial Arts and Vocational Education,* XXIV (November 1935) 335-36.

Kigin, Denis J. "The Prevention of Liability–A Corollary of Safety." *Industrial Arts and Vocational Education* LI (February 1962) 42-44.

King, Q. J. "Safety Device for Lathe Switches." *Industrial Arts and Vocational Education,* XLVII (April 1958) 137.

Kurkjian, Armen S. "Safety in the School Shop." *Industrial Arts and Vocational Education,* XXI (September 1932) 260-61.

Leavitt, Frank "Can Vocational Schools Turn Out Safe Workers." *National Safety News,* VI (December 1930) 54.

Leavitt, Jerome "Safety and Education." *Industrial Arts and Vocational Education,* XLII (October 1953) 534.

London, H. H. "Safety–A Course or a Practice?" *School Safety,* XI (April 1952) 2.

Long, C. F. "Safety Checklist for the Wood Shop." *Industrial Arts and Vocational Education,* LIV (March 1965) 103-4.

MacDonald, J. Carlisle "Safety Helps Public Relations." *National Safety News,* XXVII (July 1952).

MacFarland, Ross A. "Human Engineering Aspects of Safety." *Mechanical Engineering,* (May 1954) 407-10.

McKinney, Francis M. "Electric Tool Safety for the School Shop." *Industrial Arts and Vocational Education,* LI (February 1962) 40-42.

Merchant, Joseph "Shop Safety Rules and Aids." *Industrial Arts and Vocational Education,* XXXVI (January 1947) 42-44.

Metz, John J. "Planning the Safety Program." *Industrial Arts and Vocational Education,* XXIV (November 1935) 335-36.

. "Shop Safety and First Aid." *Industrial Arts and Vocational Education,* XXIII (October 1934) 314.

Micheels, William J. "Coordinating a Safety Program." *School Shop,* XVII (December 1957) 7.

Miller, H. Gene "Accident Repeaters May Not Be Accident Prone." *National Safety News,* XXIX (March 1953).

Miner, H. D. "Effective Shop Safety Organization." *Industrial Arts and Vocational Education,* XLVIII (January 1959) 21-22.

Mintz, Alexander and Blum, Milton L. "A Re-Examination of the Accident Proneness Concept." *Journal of Applied Psychology,* XXXIII (June 1949).

National Safety Council, "Choosing the Right Eye Protection." *National Safety News,* XCII (October 1965) 40.

______. "Good Lighting Insures Comfort and Efficiency." *National Safety News,* XXCVII (March 1963) 33-36.

______. "Guarding Machinery." *National Safety News.* XXCVII (March 1963) 201-203, 205-208.

______. "Time Saver Standards for Safety." *School Shop,* V (June 1946) 22.

Nihan, J. F., and Webster, Dan. "Personal Injury Claims Against Schools Are Increasing." *Safety Education,* XXXVIII (February 1959) 10+.

Noll, R. F. "Safety in the Drafting Room." *Safety Education,* XLIII (March 1964) 28-30.

Olsen, Fred A. "Student Injuries and Teacher Liability." *School Shop,* Part I, XX (October 1960) 21-22, 74-75, Part II (November 1960) 21-25.

O'Neil, James E. "Sight Saving Program." *School Shop,* XV (March 1956) 9.

Pascale, Gus "Make Your Shop Safer With Color." *School Shop,* XI (April 1952) 56.

Philo, Herbert E. "Are Shop Teachers Liable?" *Safety Education,* XXX (May 1951) 13-14.

Praaken, Lawrence W. "Shop Accidents." *School Shop,* XV (October 1955) 2.

______. "Nobody Knows." *School Shop,* XI (April 1952) 2.

President's Conference on Industrial Safety. "An Action Program for Shop Safety." *School Shop,* XI (April 1952) 81.

Rathbun, Jessie E. "Moral and Legal Aspects of Safety Education." *Industrial Arts and Vocational Education,* XXIII (November 1946) 379.

Reitze, Arnold W. "Visual Aids in Safety Education." *Industrial Arts and Vocational Education,* XXIII (September 1934) 272-74.

Scherer, Francis R. "Non-skid Shop Floors." *School Shop,* I (January 1942) 7.

Schmidt, H. W. "School Shop Safety." *Industrial Arts and Vocational Education,* XXXII (March 1943) 135.

School Shop Magazine, "School Shop Safety Portfolio." *School Shop,* XI (April 1952) 13, 55.

Schulzinger, Morris S. "Accident Proneness." *Industrial Medicine and Surgery,* (April 1954).

Scime, Anthony. "Recommendations for Machine Safety." *Industrial Arts and Vocational Education,* LI (March 1962) 86-91.

Shallenberger, James K. "Accident Prevention in School Shops." *Industrial Arts,* XV (June, July, August, October, November 1926) 192-94; 235-37; 267-68; 357-59; 389-90.

Shipman, Gerald W. and Adams, Russell. "Successful Safety Programs." *School Shop,* XV (January 1956) 14.

Shiras, Frank "Eye Protection Devices." *National Safety News,* XCII (October 1965) 29.

______. "New Approach to Shock Hazard in Portable Power Tools." *National Safety News,* XCI (March 1965) 54-57.

Shuman, John J. "Effective Safety Instruction Through Boys' Clubs," *Industrial Arts and Vocational Education,* XXVII (March 1938) 130-32.

______. "The Basic Causes of Accidents." *Industrial Arts and Vocational Education,* XXVII (February 1938) 49.

Silvius, G. Harold "Selected Safety Activities Performed by Industrial Arts Teachers." *Industrial Arts and Vocational Education,* XXVII (October 1948) 301-3.

Smith, C. P. "Some Specifics on School Shop Safety." *Safety Education,* XXXVIII (December 1958) 11+.

Smith, L. C. "Do Safety Men Need a New 'Training' Philosophy?" *National Safety News,* XCI (January 1965) 20-21.

______. "Do Your Actions Say What You Mean? A Self-Check Test on Safety Attitudes." *National Safety News,* XXCIII (June 1961) 33.

______. "Training Via the Incident Process." *National Safety News,* XCIII (January 1966) 22-23.

______. "Twelve Ways to Train Employees." *National Safety News,* XCI (January 1965) 28-29.

______. "What About a Training Triangle." *National Safety News,* XXCVIII (October 1963) 201-203.

Soderberg, D. G. "Safety in Machine Woodworking." *Industrial Arts and Vocational Education,* LII (June 1963) 22-23.

Stott, C. J. "Shop Safety Checklist for Shop Instructors." *Industrial Arts and Vocational Education,* XLVII (April 1958) 126-7.

Tischendorf, E. W. "School Shop Liability." *School Shop,* XII (February 1953) 11.

______. "You May Be Liable." *School Shop,* XI (April 1952) 8.

Titre, P. J. and Pelikan, R. A. "Safe Space Standards in School Shops." *Industrial Arts and Vocational Education,* LIII (March 1964) 68-9.

Trank, Gordon F. "Planning Hand Tool Safety." *National Safety News,* XXCVI (August 1962) 24.

Van Duzee, Roy R. "Safety in the School Shops." *Industrial Arts and Vocational Education,* XXXI (February 1942) 50-52.

______. "Shop Safety in West Allis Public Schools," *Industrial Arts,* XIX (March 1930) 87-90.

Wahl, John E. "Compiling and Comparing Accident Records." *National Safety News,* XCII (December 1965) 25-29.

Walgren, John "Are Shop Teachers Liable for Accidents." *School Shop,* XVI (December 1956) 11.

Welder, H. E. "Safety Education in the School Shop." *Industrial Arts and Vocational Education,* XXIX (September 1940) 276-78.

Williams, William A. "Health Hazards in the School Shop." *School Shop,* XXIV (September 1964) 34-5.

______. "Safety Education in School Shops and Laboratories." *Safety Standards,* XIII (January-February 1964) 5-8.

Willis, William W. and Olson, Delmar W. "First Aid in the Shop." *Industrial Arts and Vocational Education,* XXVII (April 1938) 172.

Willoughby, George A. "Quiz on Safety and Maintenance." *School Shop,* VII (September 1947) 20, 21.

Wyman, Mary May "Accident Records are the Best Test." *Safety Education,* XVI (October 1936) 34.

UNPUBLISHED MATERIALS

Anderson, John W. "Safety Education in High School Machine Woodworking Shops." Master's thesis, Colorado A & M College, 1951. 62 p.

Bach, Harold Henry "Legal Responsibilities of Boards of Education for School Accidents." Master's thesis, Ohio State University, 1933. 144 p.

Baird, Earl S. "A Study of Industrial Safety in Iowa as Part of the Service of the Iowa State College." Master's thesis, Iowa State College, 1932.

Barocci, Louis F. "Safety in the School Shop." Master's thesis, Stout Institute, 1938. 125 p.

Beguhn, B. A. "A Study of School Shop Accidents in the Secondary Schools of the Counties in the State of Maryland." Master's thesis, Stout Institute, 1944. 70 p.

Bergman, Rita E. "An Investigation of Adolescent Attitudes Toward Safety." Doctoral dissertation, Indiana University, 1959.

Birnbach, Sidney B. "A Comparative Study of Accident-Repeater and Accident-Free Pupils." Doctoral dissertation, New York University, 1948. 113 p.

Brownrigg, Jerry R. "Safety Education Through Woodshop Areas." Master's thesis, University of Oklahoma, 1953. 94 p.

Burghart, William F. "Safety Education in the Teachers Colleges of West Virginia." Doctoral dissertation, New York University, 1950. 282 p.

Cannon W. Lawrence "Study of Accidents and Safety Teaching in Southwest High School." Master's thesis, University of Kansas, 1936.

Carle, Robert A. "Safety in the School Shop." Master's thesis, Oklahoma Agriculture and Mechanical College, 1950. 41 p.

Chults, Chauncey S. "An Analysis of Safety Guards on Woodworking Machinery." Master's thesis, Oklahoma Agriculture and Mechanical College, 1947. 101 p.

Covey, Alvin Earl. "A Study of Safety in the Industrial Arts Woodworking Department of the Public School of Texas." Master's thesis, Agricultural and Mechanical College of Texas, 1938. 82 p.

Cressman, Paul L. "Safety Education in Pennsylvania School Shops." Doctoral dissertation, Pennsylvania State College, 1934.

Cross, Harold A. "Safe Work Practices Emphasized in the Printing Industry." Master's thesis, Wayne University, 1954. 57 p.

Davis, Carlis C. "An Analysis of General Safety Education for Industry and Vocational Schools with Specific Recommendations for Wood and Machine Shops." Master's thesis, North Texas State College, 1943. 147 p.

Erkman, Norman. "Safety in the School Print Shop Through Educational Activities." Master's thesis, Stout Institute, 1943.

Estabrooke, Edward C. "Safety and Health Education in Pennsylvania Industrial School Shops." Doctoral dissertation, Pennsylvania State College, 1939. 23 p.

Floyd, Willard N. "Safety Instruction in the Junior and Senior High School." Master's thesis, Ohio University, 1934.

Gilliland, Lonnie, Sr. "Practices in Safety Education in the Public Schools of Selected Cities in the United States." Doctoral dissertation, University of Oklahoma, 1955. 212 p.

Gjeston, Mathew E. "Safety in the Use of Woodworking Power Machinery." Master's thesis, Stout Institute, 1940. 141 p.

Hall, Samuel F. "Safety Conditions in Industrial arts Woodworking in the St. Louis Area." Master's thesis, Iowa State College, 1938. 63 p.

Henig, Max S. "The Construction of a Curriculum in Accident Prevention Instruction for Related Academic Department of a Vocational School." Doctoral dissertation, New York University, 1925.

Hornung, A. W. "An Accident and Safety Educational Program for Industrial Arts Shops in Texas and Other States." Master's thesis, Colorado State College of Agriculture and Mechanic Arts, 1936.

Howard, Edwin Elliott "A Study of Safety and Accident Prevention in School Shops and Industry." Master's thesis, Pennsylvania State College, 1931.

Hughes, Wayne P. "Safety Procedures in the School Shop." Doctoral dissertation, New York University, 1942. 396 p.

Humble, M. Keith "Practices and Provisions for Protecting Pupils in School Shops." Doctoral dissertation, University of Missouri, 1937. 175 p.

Judy, Wayne M. "Accident and Safety Education in the Industrial Arts Shops of Iowa." Master's thesis, Iowa State College, 1932.

Keck, Lewis E. "School Shop Accidents and Their Prevention." Master's thesis, Ohio State University, 1933.

Kigin, Denis J. "Tort Liability Affecting Shop Teachers with Provisions for Avoiding Accidents and Litigation." Doctoral dissertation, University of Missouri, 1959. 209 p.

Kisner, Oliver R. "Purchasing Physical Equipment for the Woodworking Shop Safety Program." Master's thesis, Oklahoma A & M College, 1948. 120 p.

Long, Roy J. "Safety Measures for Woodworking Shops in the Nebraska High Schools." Master's thesis, University of Nebraska, 1953. 74 p.

MacMillan, Robert "Safety Education in the Public Schools of the United States." Doctoral dissertation, Temple University, 1935.

McGuire, W. W. "Accident Prevention in High School Shops." Master's thesis, Agriculture and Mechanical College (Oklahoma), 1936.

Martin, Robert A. "A Study of Reported Accidents in the Detroit School Shops from 1938 to 1944." Master's thesis, Wayne University, 1945.

Nelson, Clyde A. "A Checklist of Minimum Essentials of Safety Education Needed in the Preparation of Prospective Industrial Education Teachers." Master's thesis, Chicago Teacher's College, 1958.

Nicklas, George "A Safety Education Program for the School Machine Shop." Master's thesis, Stout State College, 1951. 134 p.

Nihan, James F. "A Study of State Laws and State Education Department Regulations for Safety Education in the Public Schools." Doctoral dissertation, New York University, 1961. 352 p.

Pelikan, Robert A. "Recommended Standards for Safe Working Space Around Selected Machines and Work Stations in the Industrial Education Woodshops." Master's thesis, Northern Illinois University, 1963. 96 p.

Pitcher, Lawrence "A Study of Safety Education in the California Secondary School Shops." Master's thesis, Oregon State Agricultural College, 1935. 88 p.

Renard, Willard Raymond "A Survey and Evaluation of Safety Literature for High School Machine Shop Teachers." Master's thesis, Wayne State University, 1959. 31 p.

Roessing, Charles O. "The Needs for Safety Training in Vocational Schools for the Electrical Trade." Master's thesis, University of Pittsburgh, 1933.

Schindler, Robert B. "Safety in the School Shop." Agriculature and Mechanical College of Texas, Master's thesis, 1949. 37 p.

Schaude, Ralph H. "A Study to Determine a Safety Program for Industrial Arts Shops." Master's thesis, Colorado State College, 1938. 93 p.

Schneider, Nathaniel O. "Teacher Preparation for Safety Education." Doctoral dissertation, New York University, 1940.

Schoeknecht, Werner, H. "Determining and Presenting Safety Instruction in Industrial Education," Master's thesis, Wayne State University, 1959. 32 p.

Shinn, Harry E. "The Use of Visual Aids in Teaching Shop Safety." Master's thesis, Oklahoma Agriculture and Mechanical University, 1956. 74 p.

Stephensen, Leslie "A Discussion of School Shop Safety Activities." Master's thesis, Oklahoma Agriculture and Mechanical College, 1949. 104 p.

Thomson, Walter "Protection Used for Eye Protection." Master's thesis, Wayne University, 1955. 36 p.

Titre, Peter T. "Recommended Standards for Safe Work Space Around Selected Machines and Work Stations in the Industrial Education Machine Shop." Master's thesis, Northern Illinois University, 1963. 89 p.

Vanover, Howard L. "Safety in Fifty-Five Industrial Education Shops in Montana." Master's thesis, Iowa State College, 1955. 104 p.

Wass, Lewis E. "Evaluation of Safety Factors in the Industrial Education Shops of Davenport." Master's thesis, Iowa State College, 1946. 151 p.

Watson, Arthur Wilford "A Study to Determine the Cause and Prevention of Accidents Occurring in the Secondary School Shops of Los Angeles." Master's thesis, University of Southern California, 1937. 116 p.

Williams, W. A. "Present Status and Preferred Practice in Safety Education in Pennsylvania Vocational Industrial School Shops." Doctoral dissertation, University of Pittsburgh, 1959. 167 p.

VISUAL AIDS

Films and Filmstrips

Inspirational

Attitude for Safety. 20 min., 16 mm., sd., color and b & w, Job Corps, Staff Resources Div., 1200 - 19th Street, N.W., Washington, D.C. 1965
Summary: Designed to alert Job Corps conservation staff to accident potentials.

Be a Pro. 14 min., 16 mm., sd., color. Industrial Accident Prevention Association, 90 Harbour Street, Toronto 1, Ontario, Canada. 1965.
Summary: Portrays necessity of learning and adhering to safety procedures in industrial operation. Especially for Canadian audiences.

Everything to Lose. 26 min., 16 mm., sd., color. Caterpillar Tractor Co., Peoria, Ill. 1965.
Summary: Dramatizes consequences of taking chances in typical shop situations.

It's Your Accident. 23¾ min., 16 mm., sd., color. Association of Mill and Elevator Mutual Insurance Cos., 2 North Riverside Plaza, Chicago 60611. 1965.
Summary: Points out how emotions and attitudes can affect safety.

Instructional

Always on the Job. 20 min., 35 mm. film strip, sd., b & w, 1953. Air Reduction Sales Co., 60 E. 42nd Street, New York 10017.
Summary: Basic approach to safety in electric arc welding shown in cartoon style.

Automotive Shop Safety. 23 min., 16 mm., sd., b & w, 1963. U.S. Army Pictorial Center, 35-11 35th Avenue, Long Island City, New York 11001.
Summary: Illustrates common automotive shop situations in military operations, explaining safe procedures.

Be a Pro. 14½ min., 16 mm., sd., b & w, 1965. Chetwind Films, Ltd., 21 Greenville Street, Toronto 5, Ontario, Canada.
Summary: Just as professional athletes protect themselves with good equipment and attitudes, workers too should develop professional attitudes toward their work. Several spectacular sports scenes.

Breathing for Others. 14 min., 16 mm., sd., color. British Admiralty., U.S. Contact-International Film Bureau, Inc., 332 South Michigan Ave., Chicago 60604. 1965.
Summary: Demonstrates situations requiring mouth-to-mouth resuscitation. 1966

Case of the Cluttered Corner. 10 min., 16 mm., sd., b & w, 1958. Associated Films, Inc., 347 Madison Avenue, New York 10017.
Summary: Broken leg leads to finding out how and why the corner got cluttered.

Cause and Effect. 15 min., 35 mm., film strip, sd., b & w, 1957. Zurich Insurance Company, 111 West Jackson Blvd., Chicago 60604.
Summary: Typical occupational accident prevention.

Close Shaves. 15 min., 35 mm., film strip, sd., b & w, Zurich Insurance Co., 111 West Jackson Blvd., Chicago 60604.
Summary: Near accidents are warnings of danger.

Communication for Safety Series. (4 films). National Safety Council, 425 North Michigan Avenue, Chicago, 60611.
No. 1. *Let's Talk About Safety.* 10 min., 16 mm., sd., b & w, 1959.
Summary: Talking about safety can be a helpful habit.
No. 2. *Take a Talkie–Brief.* 10 min., 16 mm., sd., b & w, 1959.
Summary: Ten minutes a day devoted to safety talks.
No. 3. *Setting 'Em Straight.* 10 min., 16 mm., sd., b & w, 1959.
Summary: How to correct worker's unsafe habits without causing hurt feelings.
No. 4. *Let Everybody Help.* 10 min., 16 mm., sd., b & w, 1959.
Summary: Cooperation comes when workers know their ideas are wanted.

Current Facts. 22 min., 35 mm., film strip, sd., 1961. Liberty Mutual Insurance Co., 175 Berkeley Street, Boston, Mass. 02117.
Summary: Causes of electric shock accidents from cords, appartus, and portable devices.

Don't Take Chances. 13½ min., 16 mm., sd., color, 1963. International Film Bureau, Inc., 332 South Michigan Avenue, Chicago 60604.
Summary: Dramatization of the fatal result of chance taking.

Easy Does It. 15 min., 35 mm., film strip, sd., b & w, 1951. Zurich Insurance Company, 111 West Jackson Blvd., Chicago 60604.
Summary: Handling materials–includes a photo quiz.

Electricity–Principles of Safety. 11 min., 16 mm., sd., color, 1960. Coronet Instructional Films, 65 East South Water Street, Chicago 60601.
Summary: Points out common hazards of electricity and their causes.

Everybody's Job. 15 min., 35 mm., film strip, sd., b & w, 1953. Zurich Insurance Co., 111 West Jackson Blvd., Chicago 60604.
Summary: How a safety committee works.

Falls. 5 min., 16 mm., sd., b & w, Contemporary Films, Inc., 267 West 25th Street, New York 10001.
Summary: Spotlights most common cause of industrial falls.

Falls Are No Fun. 10 min., 16 mm., sd., b & w, 1957. Associated Films, Inc., 347 Madison Avenue, New York, 10017.
Summary: Cartoon treatment of situations resulting in falls.

First Aid. 29 min., 16 mm., sd., b & w, American Red Cross, 615 North Asaph Street, Alexandra, Va., 22314 or inquire of local chapter.
Summary: Basic life-saving and related skills taught in revised standard first aid course of American Red Cross.

The Guy Behind Your Back. 20 min., 35 mm. filmstrip., sd., b & w, 1953. Air Reduction Sales Co., 60 East 42nd Street, New York 10017.
Summary: The fundamental approach to safety for operators of oxyacetylene welding and cutting equipment. Cartoon style.

Heads You Win. 15 min., 35 mm. filmstrip, sd., b & w, 1954. Zurich Insurance Company, 111 West Jackson Blvd., Chicago 60604.
Summary: Safety in the small shop.

Here's How. 15 min., 35 mm. film strip, sd., b & w, 1950. Zurich Insurance Company, 111 West Jackson Blvd., Chicago 60604.
Summary: Shows how to do various industrial jobs safely and efficiently.

How to Avoid Muscle Strains. 15 min., 16 mm., sd., b & w, Bray Studies, Inc., 729 Seventh Avenue, New York 10019.
Summary: For industrial, school and general public. Basics of lifting and handling for prevention of back and muscular injury.

How to Have an Accident at Work. 8 min., 16 mm., sd., color, 1960. Walt Disney Productions, 16 mm Film Division, 350 S. Buena Vista, Burbank, Calif. or 545 Cedar Lane, Teaneck, N.J.
Summary: Donald Duck disregards all rules on the job and blames fate for his troubles.

Human Factors in Safety. (series of 4). 10 min. each, 16 mm., sd., color, and b & w. National Safety Council, 425 North Michigan Avenue, Chicago, 60611, 1965.
Summary: Teaches fundamental concepts of human behavior as related to accidents.

The Key Man Series. (4 films) Associated Films, Inc., 347 Madison Avenue, New York 10017.
No. 1. *Point of No Return.* 10 min., 16 mm., sd., b & w, 1961.
Summary: Study of consequences of an accident.
No. 2. *You're the Key Man.* 10 min., 16 mm., sd., b & w, 1961.
Summary: Decisions and attitudes of foreman can result in greater safety consciousness in workers.
No. 3. *It's the Little Things that Count.* 10 min., 16 mm., sd., b & w, 1961.
Summary: Editor of plant magazine finds out who was most responsible for the winning of top safety award.
No. 4. *People are the Puzzle.* 10 min., 16 mm., sd., b & w, 1961.
Summary: Knowing your people is the key to accident prevention.

Lucky. 18½ min., 16 mm., sd., color, 1959. Union Carbide Nuclear Co., P.O. Box 1410, Paducah, Ky. 42202.
Summary: Shows how attitudes can affect worker and his job.

Matter of Degree. 13 min., 35 mm. film strip, sd., color, 1957. Crown Zellerbach Corporation, One Bush Street, San Francisco 94119.
Summary: Outlines program for prevention of employer accidents.

Mind Your Back. 13¼ min., 16 mm., sd., color, 1965. Australian News and Information Bureau, 636 Fifth Avenue, New York 10020.
Summary: Demonstrates right and wrong methods of lifting/handling objects.

Painting Safely. 22 min., 35 mm. film strip, sd., color, 1958. California State Compensation Insurance Fund, 525 Golden Gate Avenue, San Francisco 94101.
Summary: Teaches safe practices in the painting trade.

Safety for Sure. 11 min., 16 mm., sd., b & w, U.S. Department of Agriculture, Motion Picture Service, Washington, D.C. 20250 or loan from nearest U.S. Forest Service Office.
Summary: Presents four key points to be taught on any job.

Safety in the Shop. 10 min., 16 mm., sd., b & w, Mogul's, 112 West 48th Street, New York 10019.
Summary: Emphasizes the supervisor's responsibility in teaching and maintaining safe practices.

Safety Management Films Series. (8 films) each: 10 min., 16 mm., sd., b & w, 1963. National Safety Council, 425 North Michigan Avenue, Chicago 60611.
Summary: Series deals with several elements of safety management for supervisors and foremen.
No. 1. *Run the Team*
No. 2. *Plan for Prevention*
No. 3. *Let Them Know*
No. 4. *Mind over Matter*
No. 5. *Safety is in Order*
No. 6. *Bare Minimum*
No. 7. *Guard Duty*
No. 8. *Sell Safety*

School Shop Safety. 14¾ min., 16 mm., sd., color, 1968. Film Associates, 11559 Santa Monica Blvd., Los Angeles 90025.
Summary: Covers the problem of developing safety consciousness in the industrial arts shop.

Shadow of Doubt. 5 min., 16 mm., sd., color, 1965. Pacific Telephone, Room 507, 620 C Street, San Diego, Calif.
Summary: Covers supervisors role in preventing accidents.

So You're New Around Here. 10 min., 16 mm., sd., b & w, 1955. Associated Films, Inc., 347 Madison Avenue, New York 10017.
Summary: Indoctrination of new employees in safe shop.

Stop, Look and Beware. 15 min., 35 mm. film strip, sd., b & w, 1951. Zurich Insurance Co., 111 West Jackson Blvd., Chicago 60604.
Summary: The importance of observing warning signs.

Woodworking Machines. 17 min., 35 mm. film strip, sd., b & w, 1946. Associated Films, Inc., 347 Madison Avenue, New York 10017 or regional office.
Summary: Covers all phases of safety in the wood shop from guards and machine operation to housekeeping and eye protection.

Working Safely in the Shop. 11 min., 16 mm., sd., color and b & w, 1953. Coronet Instructional Films, 65 East South Water Street, Chicago 60601.
Summary: Three essentials of school shop safety: How to keep the shop safe, how to dress, safe operation of machines.

Personal Protective Equipment

Caution–Eyes at Work. 23 min., 16 mm., sd., color, 1954. American Optical Company, Safety Products Division, Southbridge, Mass. 01551.
Summary: Importance of proper professional practices for adequate industrial eye protection programs.

Eyes Right. 16 min. 35 mm. film strip, sd., 1962. Bureau of Safety, 20 North Wacker Drive, Chicago 60606.
Summary: Eye protection equipment - manufacture, care, and use.

Disorderly Conduct. 15 min., 35 mm. slide film sd., b & w., 1952. Zurich Insurance Company, 111 West Jackson Blvd., Chicago 60604.
Summary: Covers principal factors in industrial housekeeping.

It's Up to You. 11½ min., 13 mm., sd., color, 1961. Bausch & Lomb, Film Distribution Department, Rochester, New York 14602.
Summary: Dramatic eye protection story which presents the stark reality of an eye injury.

Margin of Safety. 22 min., 16 mm., sd., b & w. Modern Talking Picture Service, Inc., 332 South Michigan Avenue, Chicago 60604.
Summary: Need for safety measures in industry, adoption of safety rules and use of safety shoes.

No Accidents. 10 min., 16 mm., sd., b & w. International Film Bureau, Inc., 332 South Michigan Avenue, Chicago 60604.
Summary: Importance of floors and machines free of shavings and litter. Also safe clothing, shoes, and goggles.

Noise and Hearing. 30 min., 16 mm., sd., color, 1957. Mine Safety Appliances Co., Braddock, Thomas and Mead Streets, Pittsburgh, Pa. 15208.
Summary: Series of three films which explain the effect of noise on hearing in industry.

One to a Customer. 11 min., 16 mm., sd., b & w, 1955. Aetna Life Affiliated Co., 151 Farmington Avenue, Hartford, Conn. 06115.
Summary: Demonstrates how protective equipment should be used in a wide variety of jobs.

Safety Shoes. Postively our Most Neglected Article of Clothing. 22 min., 16 mm., sd., color. Lehigh Safety Shoe Company, Emmaus, Pa., 1965.
Summary: Satirical treatment of use of foot protection in industry.

Take Your Choice. 12½ min., 16 mm., sd., color, 1964. Detroit Society for the Prevention of Blindness, 51 W. Warren Avenue, Detroit, Mich. 48201.
Summary: Eye protection in high school chemistry laboratory.

Tools: Hand and Power

A New Approach to Saw Safety. 12 min., 16 mm., sd., color, 1958. Brett-Guard Corporation, 100 South Van Buren Street, Englewood, N.J. 07631.
Summary: Features sponsors see-through guard.

Design for Safety. 26 min., 16 mm., sd., b & w, 1952. U.S. Department of Labor, Bureau of Labor Standards, Washington, D.C.
Summary: Safety integrated in engineering courses. Deals with machine guarding and other safety materials.

Don't Drop your Guard. 10 min., 16mm., sd., b & w, 1951. Aetna Life Affiliated Cos., 151 Farmington Avenue, Hartford, Conn. 06115.
Summary: Demonstrates protection provided by different types of machine guards.

The Grinding Wheel. 20 min., 16 mm., sd., color, 1964. Norton Co., Publicity Department, Worcester, Mass. 01606.
Summary: Care, use, storage, and dressing procedures.

Grinding Wheel Safety. 20 min., 16 mm., sd., color. Norton Co., Publicity Department, Worcester, Mass. 01606.
Summary: Principal causes of wheel breakage. Need for proper guarding. Care and selection based on ASA standard safety code.

It Didn't Have to Happen. 14 min., 16 mm., sd., b & w, 1953. International Film Bureau, Inc. 332 South Michigan Avenue, Chicago 60604.
Summary: Careless or self-assured worker who scorns use of guards and safety devices on woodworking machines endangers life.

Lock and Tag. 23 min., 16 mm., sd., color, 1957. Calvin Company, 1105 Truman Road, Kansas City, Mo. 64106.
Summary: Dramatizes isolation of equipment being repaired.

Machines. 7 min., 16 mm., sd., b & w. Contemporary Films, Inc., 267 West 25th Street, New York 10001 or 614 Davis Street, Evanston, Ill. 60201.
Summary: Reconstructs the steps that led to fatal accident caused by carelessness and handling machinery.

Safe in Hand. 20 min., 35 mm. film strip, sd., b & w, 1946. Associated Films, Inc., 347 Madison Avenue, New York 10017.
Summary: How to pick and use right tool safely.

Safety Depends on You. 13½ min., 16 mm., sd., b & w or color, 1959. Public Service Films, Inc., 6626 Romain Street, Hollywood, Calif. 90038.
Summary: Covers all general hand tool safety precautions.

Sharp as a Razor. 15½ min., 16 mm., sd., b & w or color, 1959. Public Service Films, Inc., 6626 Romain Street, Hollywood, Calif. 90038.
Summary: Sharp cutting tools are safe when used properly.

Fire Prevention and Fire Safety

Extinguish that Fire. 25 min., 16 mm., sd., color, 1965. Los Angeles City Fire Department, 217 South Hill Street, Los Angeles, Calif.
Summary: Shows classes of fires and how to handle appropriate types of extinguishers.

Are You Sure. 14½ min., 16 mm., sd., color, 1962. Associated Films, Inc., 347 Madison Avenue, New York 10017 or regional office.
Summary: Fire employees think they caused serious industrial fires. Each reviews his careless acts.

Cause for Alarm. 13 min., 16 mm., sd., b & w, 1950. Associated Films, Inc., 347 Madison Avenue, New York 10017 or regional office.
Summary: What to do in case of fire.

Flammables Engineering. 26½ min., 16 mm., sd., color, 1960. The Protectoseal Company, 1920 South Western Avenue, Chicago 60608.
Summary: Flammable liquids and their use. Also fire prevention principles applied to handling.

Know Your Fire Extinguishers. 20½ min., 16 mm., sd., color, 1950. Factory Mutual Engineering Corporation, 1151 Boston-Providence Turnpike, Norwood, Mass. 02062.
Summary: Which extinguishers suitable for different types of fires.

Waterfog, Master of Fire. 37 min., 16 mm., sd., color, Rockwood Sprinkler Company, 38 Harlow Street, Worcester, Mass.
Summary: How waterfog controls flammable liquid and the principle and operation of equipment.

Flammable Liquid Fire Safety. 20 min., 16 mm., sd., color, 1956. Factory Mutual Engineering Corporation, 1151 Boston-Providence Turnpike, Norwood, Mass. 02062.
Summary: Shows right way to handle liquids and importance of using safety containers and approved equipment.

POSTERS AND CHARTS

Poster Directory. National Safety Council, 425 North Michigan Avenue, Chicago 60611. 1966-67
Summary: Miniatures of all posters available from the Council, 58 p.

Safety Graphs. National Safety Council.
Summary: Illustrated safety talks on 22 occupational safety subjects.

Safety in Shops. Industrial Arts Packet No. 3. 3M Company, Box 3100, St. Paul, Minn. 55101.
Summary: Packet of 25 charts for overhead projection.

CATALOGS AND DIRECTORIES

American Medical Association, "Disaster Medical Care Films." The Association, 535 North Dearborn Street, Chicago 60610. 46 p.

Associated Films, Inc., "Free Loan Films–Sales and Rental Subjects." Associated Films, Inc., 347 Madison Avenue, New York 10017. 70 p.

Coronet Films, "Coronet Films." Coronet Films, Sales Department, Coronet Building, Chicago 60601, 128 p.

Encyclopedia Britannica Films, Inc., "Catalog," 425 North Michigan Avenue, Chicago 60611.

3M Company, "Visual Products, School Catalog." Visual Products Department, 2501 Hudson Road, St. Paul, Minn. 55119. 23 p.

Modern Talking Picture Service, Inc., "A Catalog of Business and Professional Films." Modern Talking Picture Service, Inc., 3 East 54th Street, New York 10022. 12 p.

National Safety Council, "National Directory of Safety Films," (annual). 425 North Michigan Avenue, Chicago 60611.

Society for Visual Education, Inc., "Educational Film Strips." The Society, 1345 Diversey Parkway, Chicago 60614. 64 p.

United States Atomic Energy Commission, "16 mm Film Catalog." The Commission, Washington, D.C. 20545. 63 p.

U.S. Department of Agriculture, "Films." Agriculture Handbook No. 14. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20241. 86 p.

University of Illinois, "Safety and Driver Education Films." The University, Champaign, Ill. 26 p.

APPENDIXES

APPENDIX A

A Master Plan Format

for

Accident Prevention in School Shops and Laboratories

State Level

I. Objectives:

A. General objectives

These must be clearly expressed and understood so they may give direction to the organization, administration, and implementation of the program.

B. Specific objectives.

These statements should deal directly with the specific aspects of the program, such as:

1. Safety legislation.

2. Accident reporting.

3. State inspections.

4. Dissemination of safety information.

5. Data-gathering and reporting.

6. Safety standards and policies.

7. Safety education activities.

II. Relationships with other agencies.

Detailed statements should be included, describing the nature of the relationships with such agencies as:

A. Local school districts.

B. Educational institutions–colleges, universities, etc.

C. Cooperating governmental agencies:

1. Departments of labor and industry.

2. Health services.

D. Cooperating safety agencies:

1. National Safety Council.

2. American Society of Safety Engineers.

3. National Society for the Prevention of Blindness.

4. National Commission on Safety Education of the National Education Association.

III. Organization pattern.

The pattern should be indicated in an outline form as well as graphically in a chart form. The distinctive elements of this pattern should include the:

A. Chief state school officer.

B. Safety director or coordinator.

C. Safety steering committee.

D. Subject area specialists.

IV. Functions.

Each of the functions of the state organization should be described in complete detail. These should include the following:

A. Legislative functions:

1. Preparation of accident prevention legislation.

2. Presentation of accident prevention legislation.

3. Preparation and dissemination of statements of policy to accompany enacted legislation.

B. Inspectional functions:

1. Preparation of policies concerning inspections of school shops and laboratories.

2. Development of inspectional procedures.

3. Securing cooperation of state inspectional agencies.

4. Administration of inspection program.

C. Fact-gathering functions:

1. Preparation of policies regarding accident records and reports.

2. Development of accident reporting procedures.

3. Administration of accident reporting program.

4. Dissemination of accident facts to local and national agencies.

V. Responsibilities of individuals.

A. Chief state school officer.

1. Has full responsibility for the accident prevention program on a state level.

2. Holds subject matter specialists responsible for the program in their fields of endeavor.

3, Authorizes necessary expenditures for the program.

4. Passes on safety policies as formulated and recommended by the safety committee, subject matter specialists and others.

B. Safety director or coordinator:

1. Represents the chief state school officer on the state safety steering committee.

2. Serves in a staff capacity without line authority.

3. Coordinates the accident prevention activities on a state level.

4. Keeps and analyzes accident records and reports.

5. Conducts activities for stimulating and maintaining the interest of state and local education staff members.

6. Serves on the state safety steering committee as secretary.

7. Issues periodic reports showing safety performance and accident trends.

8. Advises the chief state school officer on accident prevention matters.

C. Safety steering committee:

1. Formulates safety policies and recommends their adoption by the chief state school officer.

2. Works to obtain results by having its approved recommendations put into practice.

3. Arouses and maintains the safety interest of the state and local staffs, and helps them understand that "safety is everybody's business."

4. Provides an opportunity for free discussion of accident problems and preventive measures.

5. Assists the chief state school officer to evaluate the accident prevention program.

6. Advises and counsels the safety director on accident prevention policy matters.

D. Subject area specialists.

1. Work with the safety steering committee, safety director, and chief state school officer on all matters pertaining to accident prevention in their respective areas of education.

2. Assist in developing proper staff safety attitudes and practices.

3. Make suggestions for eliminating the unsafe practices of teaching, and supervisory personnel.

4. Cooperate with the safety steering committee and the safety director in the operation of the state program of accident prevention.

APPENDIX B

A Master Plan Format
for
Accident Prevention in School Shops and Laboratories
Local Level

I. Objectives.

A. General objectives.

These must be clearly expressed and understood so they may give direction to the organization, administration, and implementation of the program.

B. Specific objectives.

These statements should deal directly with the specific aspects of the program, such as:

1. Local safety regulations.
2. Accident reporting.
3. Shop and laboratory inspections.
4. Accident records and reports.
5. Safety education activities.

II. Relationships with other agencies.

Detailed statements should be included, describing the nature of the relationships with such agencies as:

A. State departments of education.

B. Educational institutions–colleges, universities, etc.

C. Cooperating governmental agencies:

1. State department of labor and industry.
2. Health services.
3. Municipal fire departments.

D. Cooperating safety agencies, such as:

  1. National Safety Council.

  2. Local safety council.

  3. Local chapter of the American Society of Safety Engineers.

  4. Local Red Cross chapter.

III. Organization pattern.

The pattern should be indicated in an outline form as well as graphically in a chart form. The distinctive elements of this pattern should include the:

A. Local superintendent of schools.

B. Safety director or coordinator.

C. Safety steering committee.

D. School principals.

E. Subject area specialists.

F. School shop and laboratory teachers.

IV. Functions

Each of the functions of the local organization should be described in complete detail. These should include the following:

A. Inspectional functions:

  1. Preparation of policies concerning inspections of school shops.

  2. Development of inspectional procedures.

  3. Securing cooperation of state inspectional agencies.

  4. Administration of inspection program.

B. Fact-gathering functions:

  1. Preparation of policies regarding accident records and reports.

  2. Development of accident reporting procedure.

3. Administration of accident reporting program.

4. Dissemination of accident facts to state agencies.

V. Responsibilities of individuals.

A. Local superintendent of schools:

1. Has full responsibility for the local accident prevention program in school shops and laboratories.

2. Holds teachers responsible for the safety of all students under their jurisdiction.

3. Authorizes necessary expenditures for the accident prevention program.

4. Passes on safety policies as formulated and recommended by the safety steering committee, safety director, department heads, teachers, and others.

5. Participates in the accident prevention program as recommended by the steering committee, safety director, and others.

B. Safety director or coordinator:

1. Formulating, administering, and making necessary changes in the accident prevention program.

2. Submitting directly to the school administrator regular monthly, weekly, or daily reports on the status of the accident prevention program.

3. Acting in an advisory capacity on all matters pertaining to accident prevention as required for the guidance of the school administrator or the safety committee.

4. Maintaining the accident record system, making necessary reports, making personal investigation of fatal or serious accidents, investigating accidents, and checking corrective action taken by teachers or other personnel to eliminate accident causes.

5. Supervising or closely cooperating with subject-matter supervisors in the safety training of students.

6. Making personal inspections for the purpose of discovering and correcting unsafe conditions or unsafe work practices before they cause accidents.

7. Maintaining outside professional contacts to exchange information with others and to keep the accident prevention program up to date.

8. Making certain that federal, state, or local laws, ordinances, or orders, bearing on safety are complied with.

9. Securing necessary help or advice from state labor departments or insurance carriers on matters pertaining to the safety and health of students or other school personnel.

10. Starting activities that will stimulate and maintain teacher and student interest in accident prevention.

11. Controlling or supervising fire prevention and fire-fighting activities where they are not the responsibility of specific departments.

12. Setting standards for safety equipment to be used by school personnel.

C. Safety steering committee:

1. Arouse and maintain the interest of school administrators, supervisors, and teachers and to help them understand that safety is everybody's business.

2. Arouse and maintain the interest of students and convince them that they are largely responsible for accidents and that their cooperation is needed to prevent them.

3. Make safety activities an integral part of operating policies and a function of operation.

4. Provide an opportunity for free discussion of accident problems and preventive measures.

5. Discuss and formulate accident prevention policies and recommend their adoption by school administrators.

6. Discover unsafe conditions and practices and determine remedies.

7. Work to obtain results by having its administration-approved recommendations put into practice.

D. School principals:

1. Have full responsibility for accident prevention on the school level.

2. Hold teaching staff responsible for the safety of all students.

3. Actively and openly support the accident prevention program of the school.

4. Establish and endorse an accident prevention program on the shop or laboratory level.

E. Teachers:

1. Incorporate safety instruction in the course of study.

2. Give instruction on hazards and accident prevention specific to the particular school shop or laboratory.

3. Give instruction and promote activities which will lead to accident prevention in future employment.

4. Foster student cooperation in accident prevention.

5. Follow all safety practices personally.

6. Keep informed about modern and accepted safe practices in the subject field.

7. Revise shop facilities to provide for optimum safety conditions. Give special attention to a) shop layout, b) utilities and building services, c) equipment and tools, d) storage and handling of materials.

8. Carry out recommendations of the administrator for improving safety instruction or safe working conditions.

9. Devise and enforce safe housekeeping procedures.

10. Provide for use of necessary personal protective equipment.

11. Develop specific safe practices and regulations.

12. Make recommendations to administrators for improving shop safety conditions.

APPENDIX C

An Outline for a School Shop Safety Program

I. Objectives.

These must be clearly expressed and understood so they may give direction to the teaching. for example: is a major objective to prevent accidents in the school shop only—or to so train the student that he will avoid accidents after he enters employment and in his future non-vocational activities.

A. General objectives applicable in any shop or laboratory.

B. Specific objectives applicable to a machine shop.

II. Layout and facilities of the shop

A listing of the physical features of a shop, both structural and movable, will permit an analysis of hazards, methods of prevention and the necessary related instruction. Each item listed can be elaborated on as necessary for more detailed consideration. Such a listing can be used for the more general purposes of the administrator as well as for a basis for specific action by the teacher while the class is in action. It not only points up the establishment of a safe environment but also indicates specific teaching activities.

A. Floor plan drawn to scale:

1. General shop space, adjoining auxiliary rooms, tool storage, and group seating arrangements.

2. All principal items of equipment.

3. Aisles, work areas, traffic areas, exits, and passageways.

4. Location of sanitary facilities, lockers, heat and power sources, fire protection, other safety equipment, and waste disposal.

B. Inventory of operating equipment which involves accident hazards to operators and to others.

1. Lathes.

NOTE: This outline was extracted from *Accident Prevention Manual for Shop Teachers,* William A. Williams (ed.). Chicago: American Technical Society, pp. 54-59.

2. Drill presses.
3. Milling Machines.
4. Shapers.
5. Power saws.
6. Grinders.
7. Furnaces.
8. Heat treating equipment.
9. Arbor presses.
10. Vises.
11. Surface and bench plates.
12. Welding equipment.
13. Sheet metal cutting and forming equipment.
14. Melting and casting equipment.
15. Other machines and major pieces of equipment.

C. Inventory of hand and portable tools which involve accident hazards:

1. Hand tools.

   Files, wrenches, hammers, pliers, snips, saws, scrapers, screwdrivers, gages, measuring instruments.

2. Portable power tools.

   Electric drills, electric grinders.

D. Description of building services which involve accident hazards:

1. Lighting–adequacy and condition.
2. Heating.
3. Ventilation.

4. Dust collection.
5. Fume exhaust.
6. Electric power supply.
7. Gas.
8. Compressed air.
9. Hoists and trucks.

III. Shop operation and maintenance.

A consideration of the details of the routine of operation and management of a complex school machine shop or general metal shop will bring to mind sources of specific hazards, as well as necessary and effective teaching procedures related to most of these categories.

A. Description of method of storage and handling of materials and tools:

1. Storage of raw stock.
2. Storage of unfinished work.
3. Handling material in the shop.
4. Safety in the storing and management of tools.
    - a. Handling tools.
    - b. Checking tools for defects.
    - c. Hanging and mounting tools.
    - d. Orderly checking tools in and out.

B. Housekeeping procedures:

1. Care of floors, stairs, aisles.
2. Care of rags and waste.
3. Care of oils and solvents.
4. Shop cleanliness and clean-up.

IV. Description of equipment used for the protection of the student.

This portion of the inventory of a school shop safety program is concerned with items to be provided for the student or for his environment, or with environmental requirements to be met. It consists of deterrents and safeguards to protect students from unavoidable hazards. The following list may be expanded and/or adapted to apply to a specific shop in a specific school.

A. Personal protective equipment and clothing:

   1. Safety goggles, face shields, and helmets.

   2. Gloves.

   3. Shoes.

   4. Coveralls and aprons.

B. Fire protection equipment:

   1. Fire extinguishers.

   2. Fire alarms and sprinklers.

   3. Fire blankets.

C. Dust collection and fume exhaust.

D. Machine and power transmission guards.

E. Sanitary facilities.

F. Painting for better seeing.

G. Provisions for waste disposal.

H. Adequate lighting.

I. Protection against electrical hazards.

V. List of safe practices and regulations.

Students need guidance in safe shop behavior. Much of this guidance can be incorporated in predetermined safe practices to be followed. A listing of student orientation procedures, general safe practices of wide application and statements of specific safe practices can form a catalog of accident prevention procedures for the student and an important part of a program for the teacher.

A. Orientation of the student to the shop:

1. Analysis of student records for evidence of mental and physical handicaps.
2. Acquainting the students (either group or individual) with layout and equipment.
3. Regulations concerning entering and leaving the shop.
4. Regulations concerning clean-up and dismissal.

B. General policies for safe operation:

1. Conduct and attitudes.
2. Appropriate clothing.
3. Personal hygiene and cleanliness.
4. Lifting and carrying.
5. Materials loading and storage.
6. Good housekeeping.
7. Fire prevention and drills.
8. Use of tool storage facilities and store rooms.
9. What to do in case of an accident.
10. Acceptable practice for moving about the room.
11. Disposal of scrap and waste.

C. Specific statements of safe practices and precautions in operating particular machines in the machine shop.

D. Specific statements of safe practices and precautions in the use of tools and materials peculiar to the machine shop.

VI. Safety instruction plans.

Many aspects of school shop safety lend themselves to planned group or individual instruction, either integrated with manipulation instruction or segregated in separate lessons. The course of study should make reference to major topics and consider the most desirable methods of teaching safety.

A. Individual instruction:

  1. Individual demonstration.
  2. Observation and evaluation of individuals.
  3. Safety analysis of each job or operation.
  4. Instructional materials showing safety precautions.

B. Group instruction:

  1. Lesson plans for group lessons.
  2. Plans for group instruction.
  3. Films on safety.
  4. Notebook work to be required.
  5. Field trips.
  6. Group tests on safety.

C. Additional visual aids to be used:

  1. Posters.
  2. Displays.
  3. Bulletins.
  4. Exhibits.

VII. Description of student participation in the safety program.

Actual student participation and activity can provide motivation and effective informal instruction in a safety program. The type of activities listed below can help students to become interested in and to believe in safety. They tend to accept activities, with consequent learning, when they become real participants.

A. The student safety foreman.

B. The safety committee.

C. Safety contests.

D. Safety meetings.

E. Safety news for the school paper.

F. Visits to safety exhibits and industrial safety conferences.

VIII. Policy for making accident reports and analyses.

Accident reports and the analysis of accidents are usually required and follow established practices of the school system. However, they can also provide direction to the accident prevention program by indicating real occurrences and problems.

A. Accident report forms.

B. Accident analysis for prevention purposes.

C. Accident records on problem students.

This Guide was prepared by the Pennsylvania State University under a contract with the U.S. Office of Education. Dr. William A. Williams, Professor of Industrial Education at the Pennsylvania State University, an expert in the field and author of other related safety publications, planned and prepared the manuscript.

Walter M. Arnold
Assistant Commissioner for
Vocational and Technical Education

APPENDIX D

Acknowledgment of Safety Instruction and Pledge

I have received the SAFETY INSTRUCTIONS regarding the operation of the following power driven machines. I fully understand the importance of these rules and regulations and I am fully aware that the violation of any one of them may endanger myself and others.

My teacher has demonstrated to me the proper methods of using each machine listed below and has pointed out the safety precautions necessary to avoid injury.

I have demonstrated my ability to use each machine listed below in the presence of my teacher. I understand the safety precautions involved and understand how to insure my safety through the proper use of the machines. I am confident that I can operate these machines safely. When in doubt about the operation of any machine, or other equipment, I will consult the teacher before proceeding.

(Name of each machine to be written in *by the pupil* only after he has passed the safety tests and demonstrated his ability to use it.)

Name of Machine	Date	Student's Signature	Teacher's Initials
1			
2			
3			
4			
5			
6			

I have passed the tests covering safety in the shop and the use of the above listed machines.

I promise to observe the SAFETY INSTRUCTIONS and to follow the instructions given in the demonstration. I may use the machines only after I have been properly instructed in their safe use, and have had the approval of the teacher. I understand that the use of machines in this shop is voluntary on my part.

School ______________________ Signed ______________________
Pupil

Date ______________________ ______________________
Teacher

APPENDIX E

Sources of Help–
National Organizations

American Insurance Association, Engineering and Safety, 85 John Street, New York City 10038

Educational, statistical, and engineering service organization. Materials include inspection blanks for checking fire hazards, standards, and recommended practices.

American Medical Association, 535 N. Dearborn Street, Chicago, 60610

Concerned with industrial nursing, workmen's compensation and rehabilitation, occupational dermatoses and industrial opthalmology. Published materials.

American Mutual Insurance Alliance, Accident and Fire Prevention Department, 20 North Wacker Drive, Chicago, 60606

Technical safety data and materials.

American National Red Cross, 17th and E Streets, N.W., Washington, D.C. 20006

First aid texts and courses, instructor's manuals, charts and other teaching materials. Visual aids, such as films and posters available through local chapters.

American Petroleum Institute, Safety and Fire Protection Services, 1271 Avenue of Americas, New York City 10020

Safety and fire protection manuals related to petroleum industry.

American Society of Safety Engineers, 5 North Wabash Avenue, Chicago, 60602

Professional society for safety specialists. Many local chapters have active assistance programs for schools.

American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103

Sponsors research in the properties of engineering materials and develops standards, including specifications and test methods.

American Welding Society, 345 East 47th Street, New York City 10017

Materials dealing with proper and safe use of welding by industry.

Association of Casualty and Surety Companies, Accident Prevention Department, 110 William Street, New York City 10038

Pamphlets covering a wide range of subjects to meet needs of specific industries and job categories.

Department of Labor, 14th Street and Constitution Avenue, N.W., Washington, D.C. 20216

Wide variety of publications dealing with occupational safety. List of publications available.

Factory Mutual, Division of Associated Factory Mutual Fire Insurance Companies, 1151 Boston-Providence Turnpike, Norwood, Mass. 02062

Tests and lists fire protection equipment for approval, assists in development of better standards, conducts research in industrial fire protection, conducts courses on fire safety in industry.

Illuminating Engineering Society, 345 E. 47th Street, New York City 10017

The scientific and engineering stimulus in the field of lighting. Materials on all phases of lighting.

Industrial Hygiene Foundation of America, Inc., 4400 Fifth Avenue, Pittsburgh, Pa. 15231

Gives direct professional help to member companies. Assists companies in development of health programs. Contributes to technical advancement of industrial health and hygiene through research, investigation and allied activities.

International Acetylene Association, 205 East 42nd Street, New York City 10017

Technical publications dealing with calcium carbide, acetylene and allied products.

Manufacturing Chemists' Association, Inc., 1825 Connecticut Avenue, N.W., Washington, D.C. 20036

A trade organization for the chemical industry; publishes valuable information on chemical safety.

National Commission on Safety Education, National Education Association, 1201–16th Street, N.W. Washington, D.C. 20036

Magazines, bulletins, pamphlets, checklists, posters for all levels of education and all aspects of safety education.

National Fire Protection Association, 60 Batterymarch Street, Boston, Mass. 02110

Clearing house for information on fire protection and fire prevention. Technical standards are widely accepted by state and municipal governments.

National Safety Council, 425 North Michigan Avenue, Chicago, 60611

Accident prevention programs, materials and technical assistance. Wide variety of materials for all aspects of accident prevention. Books, pamphlets, data sheets, technical releases, films, posters, etc. Conducts National Safety Congress each October.

National Society for the Prevention of Blindness, 16 East 40th Street, New York City 10016

Materials, consultation and technical service for conservation and utilization of eyesight in industry. Sponsors conferences and courses for lay and professional groups. Sponsors "Wise Owl Club of America."

New York University, Center for Safety Education, Washington Square, New York City 10003

Courses, research and materials on all phases of safety education and accident prevention.

Public Health Service, Department of Health, Education, and Welfare, Washington, D.C. 20202

Division of Accident Prevention offers materials and consultation service on accident prevention programs.

Underwriters' Laboratories, Inc., 207 East Ohio Street, Chicago, 60611

Maintains laboratories for examination and testing of devices, systems, and materials to determine their safety. Safety engineers regard the Underwriters' label as a requisite when they purchase fire, electrical, and other equipment.

United States of America Standards Institute, 10 East 40th Street, New York City 10016

The national standards body in the United States. Prime purpose is to provide the machinery for an orderly and voluntary method of establishing recognized United States of America Standards. Standards are generally accepted as minimum requirements by safety engineers.

APPENDIX F

Model School Eye Safety Law

A sample legislative bill, containing the essentials for basic eye protection among school laboratory and shop students, teachers, and visitors, has been drawn up by the National Society for the Prevention of Blindness, Inc. as a guide for all organizations and individuals interested in visual health and safety.

With a three-state nucleus, the NSPB hopes for a cross-country wave of state laws requiring students, teachers, and visitors to wear eye protection in school: vocational, industrial arts, and chemical-physical science courses or labs. The State of Ohio was the first to pass such legislation in 1963, and similar laws have been approved in Massachusetts and Maryland in 1964.

THE NSPB SAMPLE BILL:

An act to enact legislation requiring all students and teachers to wear eye protective devices when participating in certain vocational, industrial arts, and chemical-physical courses or laboratories.

Be it enacted by the legislature of the State of ______________________________
SECTION I. Every student and teacher in schools, colleges, and universities participating in any of the following courses:

(A) Vocational or industrial arts shops or laboratories involving experience with:

1. Hot molten metals;
2. Milling, sawing, turning, shaping, cutting, grinding, or stamping of any solid materials;
3. Heat treatment, tempering, or kiln firing of any metal or other materials;
4. Gas or electric arc welding;
5. Repair or servicing of any vehicle;
6. Caustic or explosive materials;

(B) Chemical or combined chemical-physical laboratories involving caustic or explosive chemicals or hot liquids or solids; is required to wear industrial quality eye protective devices at all times while participating in such courses or laboratories. Such devices may be furnished for all students and teachers, and shall be furnished for all visitors to such classrooms and laboratories. Such devices may be purchased in large quantities and sold at cost to students and teachers.

"Industrial quality eye protective devices," as used in this section, means devices meeting the standards of the United States America Standards Institute Safety Code for Head, Eye, and Respiratory Protection, Z2.1-1959, promulgated by the United States America Standards Institute, Inc.

The National Society for the Prevention of Blindness, Inc. is the only national voluntary health agency devoted exclusively to sight conservation through a total program of research, community service and public and professional education. Publications, posters, films, lectures, charts, and advisory service are available on request. Working nationally and through state affiliates, it has headquarters at 16 East 40th Street, New York, N.Y. 10016.

NOTE: As of March 10, 1966, the following states have passed school eye safety laws based on NSPB's Model Law: Alabama, Arkansas, California, Florida, Illinois, Iowa, Maryland, Massachusetts, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, South Carolina, Texas, Utah, and Virginia.

APPENDIX G

BETHLEHEM STEEL

JOB SAFETY ANALYSIS

29276 (Rev.C 1-66)

INSTRUCTIONS ON REVERSE SIDE

Plant	Job operation title
Department	
Section	Position title of man (men) who does (do) the job

Required and/or recommended personal protective equipment

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURE

APPROVED:...DATE..............................

(CONTINUE ON REVERSE SIDE)

Signature of person making Job Safety Analysis

Date

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURE

Break the job down into its basic steps; e.g., what is done first, what is done next, and so on. You can do this by (1) observing the job, (2) discussing it with the operator, (3) drawing on your knowledge of the job, or (4) a combination of all three. Record the job steps in their normal order of occurrence. Describe what is done, not the details of how it is done. Usually three or four words are sufficient to describe each basic job step. For example, the job of "replacing a light bulb" may break down into basic steps as follows:

1. Get a step-up ladder.
2. Climb ladder.
3. Remove light globe.
4. Replace light bulb.
5. Replace light globe.
6. Descend ladder.
7. Remove and store ladder.

For each job step, ask yourself what accidents could happen to the man doing the job step. You can get your answers by (1) observing the job, (2) discussing it with the operator, (3) recalling past accidents, or (4) a combination of all three. Ask yourself: Can he be struck by or contacted by anything; can he strike against or come in contact with anything; can he be caught in, on, or between anything; can he fall; can he overexert; is he exposed to anything injurious such as gas, radiation, welding rays, etc.

Record and number potential accidents by using the right abbreviation for the type of accident that could happen and by describing the agent of contact or exposure. For example, SB—cranehook means the man could be struck by a cranehook. Use these abbreviations:

1. SB—Struck by
2. CBy—Contacted by
3. SA—Struck against
4. CW—Contact with
5. CBe—Caught between
6. CO—Caught on
7. CI—Caught in
8. FB—Fall-to-below
9. FS—Fall-same-level
10. O—Overexertion
11. E—Exposure

For each potential accident or hazard, ask yourself how should the man do the job step to avoid the potential accident, or what should he do or not do to avoid the potential accident. You can get your answers by (1) observing the job for leads, (2) discussing precautions with experienced job operators, (3) drawing on your experience, or (4) a combination of all three. Be sure to describe specifically the precautions the man must take. Don't leave out important details. Number each separate recommended precaution with the same number you gave the potential accident (center column) that the precaution seeks to avoid. Use simple do or don't statements to explain recommended precautions as if you were talking to the man.

For example: "Stand clear of lift before signaling."

Avoid such generalities as "Be careful," "Be alert," "Take caution," etc.

Then, even before you have completed this column, ask yourself if there is a different way to do the job that is safer and better all around. Consider such improvements as more efficient tools, equipment, materials, or methods. If it is a service job, also consider ways to increase the life of the job. If you have any such ideas, jot down the core of the idea, and then discuss it with higher supervision at first opportunity.

29276 (Rev.C 1-66) Reverse Printed in U.S.A.

(USE ADDITIONAL FORM IF NECESSARY)

NATIONAL STANDARD SCHOOL SHOP SAFETY INSPECTION CHECK LIST

Prepared by the Joint Safety Committee of the
AMERICAN VOCATIONAL ASSOCIATION — NATIONAL SAFETY COUNCIL

____ Date______________________

____

INTRODUCTION

A safe environment is an essential part of the school shop safety education program. The safe environment will exist only if hazards are discovered and corrected through *regular* and *frequent* inspections by school personnel—administrators, teachers and students. Safety inspections are to determine if everything is satisfactory.

Inspections may be made at the request of the board of education, the school administration or upon the initiative of the teacher. Some communities have drawn upon the cooperative service of professional safety engineers, inspectors of state labor departments, insurance companies and local safety councils to supplement and confirm inspections by school personnel.

The National Standard School Shop Safety Inspection Check List, recommended by the President's Conference on Industrial Safety is an objective inspection procedure for the school shop.

DIRECTIONS

WHO INSPECTS?

This will depend upon local policies. It is recommended, however, that shop teachers, and students—the student safety engineer and/or student safety committee—participate in making regular inspections. This not only tends to share responsibility but stimulates a broader interest in the maintenance of a safe school shop.

WHEN TO INSPECT?

As a minimum, a safety inspection should be made at the beginning of every school term or semester. More frequent inspections may be advisable.

HOW TO INSPECT?

Inspections should be well planned in advance.

Inspections should be systematic and thorough. No location that may contain a hazard should be overlooked.

Inspection reports should be clear and concise, but with sufficient explanation to make each recommendation for improvement understandable.

FOLLOW-UP

The current report should be compared with previous records to determine progress. The report should be studied in terms of the accident situation so that special attention can be given to those conditions and locations which are accident producers.

Each unsafe condition should be corrected as soon as possible in accordance with accepted local procedures.

A definite policy should be established in regard to taking materials and equipment out of service because of unsafe conditions.

The inspection report can be used to advantage as the subject for staff and class discussion.

CHECKING PROCEDURE

Draw a circle around the appropriate letter, using the following letter scheme:

S — Satisfactory (needs no attention)
A — Acceptable (needs some attention)
U — Unsatisfactory (needs immediate attention)

Recommendations should be made in all cases where a "U" is circled. Space is provided at the end of the form for such comments. Designate the items covered by the recommendations, using the code number applicable (as B-2).

In most categories, space is provided for listing of standards, requirements or regulations which have local application only.

A. GENERAL PHYSICAL CONDITION

1. Machines, benches, and other equipment are arranged so as to conform to good safety practices........................ S A U
2. Condition of stairways............................ S A U
3. Condition of aisles................................ S A U
4. Condition of floors................................ S A U
5. Condition of walls, windows, and ceiling............. S A U
6. Illumination is safe, sufficient, and well placed....... S A U
7. Ventilation is adequate and proper for conditions..... S A U
8. Temperature control .... S A U
9. Fire extinguishers are of proper type, adequately supplied, properly located and maintained.......................... S A U
10. Teacher and pupils know location of and how to use proper type for various fires..................................... S A U
11. Number and location of exits is adequate and properly identified .... S A U
12. Proper procedures have been formulated for emptying the room of pupils and taking adequate precautions in case of emergencies S A U
13. Lockers are inspected regularly for cleanliness and fire hazards. S A U
14. Locker doors are kept closed....................... S A U
15. Walls are clear of objects that might fall............ S A U
16. Utility lines are properly identified.................. S A U
17. Teachers know the procedure in the event of fire including notification of the fire department and the evacuation of the building. S A U
18. Air in shop is free from excessive dust, smoke, etc.... S A U
19. ______________________________ S A U
20. ______________________________ S A U
21. ______________________________ S A U
22. ______________________________ S A U
23. Evaluation for the total rating of A. GENERAL PHYSICAL CONDITION .... S A U

B. HOUSEKEEPING

1. General appearance as to orderliness................ S A U

2. Adequate and proper storage space for tools and materials. S A U

3. Benches are kept orderly........................... S A U

4. Corners are clean and clear......................... S A U

5. Special tool racks, in orderly condition, and provided at benches and machines .... S A U

6. Tool, supply, and/or material room is orderly........ S A U

7. Sufficient scrap boxes are provided.................. S A U

8. Scrap stock is put in scrap boxes promptly........... S A U

9. Materials are stored in an orderly and safe condition.. S A U

10. A spring lid metal container is provided for waste and oily rags. S A U

11. All waste materials and oily rags are promptly placed in the containers .... S A U

12. Containers for oily rags and waste materials are frequently and regularly emptied .... S A U

13. Dangerous materials are stored in metal cabinets..... S A U

14. Machines have been color conditioned............... S A U

15. Safety cans are provided for flammable liquids....... S A U

16. Bulk storage of dangerous materials is provided outside of the main building .... S A U

17. A toe-board or railing around a mezzanine used for storage or washing facilities .... S A U

18. Materials are stored in an orderly and safe condition on this mezzanine .... S A U

19. Flammable liquids are not used for cleaning purposes S A U

20. Floors are free of oil, water and foreign material..... S A U

21. Floors, walls, windows, and ceilings are cleaned periodically. S A U

22. ________________________________ S A U

23. ________________________________ S A U

24. ________________________________ S A U

25. ________________________________ S A U

26. Evaluation for the total rating for B. HOUSEKEEPING S A U

C. EQUIPMENT

1. Machines are arranged so that workers are protected from hazards of other machines, passing students, etc.................. S A U

2. Danger zones are properly indicated and guarded..... S A U

3. All gears, moving belts, etc., are protected by permanent enclosure guards .... S A U

4. All guards are used as much as possible.............. S A U

C. EQUIPMENT (continued)

5. All equipment control switches are easily available to operator. S A U

6. All machines are "locked off" when instructor is out of the room. S A U

7. Brushes are used for cleaning equipment............. S A U

8. Nonskid areas are provided around machines........ S A U

9. Machines are in safe working condition.............. S A U

10. Machines are guarded to comply with American Standards Association and local state code........................... S A U

11. Adequate supervision is maintained when students are using machines and dangerous tools............................. S A U

12. Tools are kept sharp, clean and in safe working order S A U

13. All hoisting devices are in safe operating condition... S A U

14. Machines are shut off while unattended............. S A U

15. Adequate storage facilities for tools, equipment, etc., not in immediate use .... S A U

16. ________________________________ S A U

17. ________________________________ S A U

18. ________________________________ S A U

19. ________________________________ S A U

20. Evaluation for the total rating for C. EQUIPMENT.. S A U

D. ELECTRICAL INSTALLATION

1. All switches are enclosed.......................... S A U

2. There is a master control switch for all of the electrical installations .... S A U

3. Electrical outlets and circuits are properly identified.. S A U

4. All electrical extension cords are in safe condition and are not carrying excessive loads............................. S A U

5. All machine switches are within easy reach of the operators. S A U

6. Electrical motors and equipment are wired to comply with the National Electric Code............................... S A U

7. Individual cut-off switches are provided for each machine. S A U

8. Machines are provided with overload and underload controls by magnetic pushbutton controls.......................... S A U

9. No temporary wiring in evidence................... S A U

10. ________________________________ S A U

11. ________________________________ S A U

12. ________________________________ S A U

13. ________________________________ S A U

14. Evaluation for the total rating for D. ELECTRICAL INSTALLATION ....S A U

E. GAS

1. Gas flow to appliances is regulated, so that when appliance valve is turned on full, the flames are not too high............ S A U

2. Gas appliances are properly insulated with asbestos or other insulating material from tables, benches, adjacent walls, or other flammable materials .... S A U

3. No gas hose is used where pipe connections could be made. S A U

4. Gas appliances have been adjusted so that they may be lighted without undue hazard................................ S A U

5. Students have been instructed when lighting gas appliances to light the match first before turning on the gas............ S A U

6. There are no gas leaks, nor is any odor of gas detectable in any part of the shop.. S A U

7. Shop instruction has been given concerning the lighting of gas furnaces operating with both air and gas under pressure.. S A U

8. When lighting the gas forge, goggles are worn....... S A U

9. When lighting the gas furnace, the following procedure is used: (a) light the match; (b) turn on the gas; (c) drop the match in the hole in top of the furnace............................. S A U

10. In shutting down the gas furnace, the gas valve is closed before the air valve... S A U

11. ______________________________ S A U

12. ______________________________ S A U

13. ______________________________ S A U

14. ______________________________ S A U

15. Evaluation for the total rating for E. GAS.......... S A U

F. PERSONAL PROTECTION

1. Goggles or protective shields are provided and required for all work where eye hazards exist.......................... S A U

2. If individual goggles are not provided, hoods and goggles are properly disinfected before use......................... S A U

3. Shields and goggles are provided for electric welding.. S A U

4. Rings and other jewelry are removed by pupils when working in the shop... S A U

5. Proper kind of wearing apparel is worn and worn properly for the job being done.................................... S A U

6. Leggings, safety shoes, etc., are worn in special classes such as foundry, etc., when needed .... S A U

7. Respirators are provided for dusty or toxic atmospheric conditions such as when spraying in the finishing room......... S A U

8. Provisions are made for cleaning and sterilizing respirators. S A U

9. Students are examined for safety knowledge ability.. S A U

10. Sleeves are rolled above elbows when operating machines. S A U

11. Clothing of students is free from loose sleeves, flopping ties, loose coats, etc. .... S A U

12. ______________________________ S A U

F. PERSONAL PROTECTION (continued)

13. ______________________________ S A U

14. ______________________________ S A U

15. ______________________________ S A U

16. Evaluation for the total rating for F. PERSONAL PROTECTION. S A U

G. INSTRUCTION

1. Shop Safety is taught as an integral part of each teaching unit. S A U

2. Safety rules are posted particularly at each danger station. S A U

3. Printed safety rules are given each student.......... S A U

4. Pupils take a safety pledge........................ S A U

5. Use of a safety inspector.......................... S A U

6. Use of a student shop safety committee.............. S A U

7. Use of safety contests.............................. S A U

8. Motion and/or slide films on safety are used in the instruction. S A U

9. Use of suggestion box............................ S A U

10. Use of safety tests.............................. S A U

11. Use of safety posters............................ S A U

12. Talks on safety are given to the classes by industrial men. S A U

13. Tours are taken of industrial plants as a means of studying safety practices .... S A U

14. Periodic safety inspections of the shop are made by a student committee .... S A U

15. Men from industry make safety inspections of the shop S A U

16. Student shop safety committee investigates all accidents S A U

17. A proper record is kept of safety instructions which are given, preferably showing the signature of student on tests given in this area .... S A U

18. Rotate students on the Shop Safety Committee so that as many students as possible have an opportunity to participate... S A U

19. ______________________________ S A U

20. ______________________________ S A U

21. ______________________________ S A U

22. ______________________________ S A U

23. Evaluation for the total rating of G. INSTRUCTION S A U

H. ACCIDENT RECORDS

1. There is a written statement outlining the proper procedure when and if a student is seriously hurt....................... S A U

2. Adequate accident statistics are kept................ S A U

3. Accidents are reported to the proper administrative authority by the instructor .... S A U

H. ACCIDENT RECORD (continued)

4. A copy of each accident report is filed with the State Department of Education .... S A U

5. Accident reports are analyzed for instructional purposes and to furnish the basis for elimination of hazards.............. S A U

6. ______________________________ S A U

7. ______________________________ S A U

8. ______________________________ S A U

9. ______________________________ S A U

10. Evaluation for the total rating of H. ACCIDENT RECORDS. S A U

I. FIRST AID

1. An adequately stocked first aid cabinet is provided... S A U

2. The first aid is administered by a qualified individual S A U

3. The school has individuals qualified to administer first aid. S A U

4. ______________________________ S A U

5. ______________________________ S A U

6. ______________________________ S A U

7. ______________________________ S A U

8. Evaluation for the total rating of I. FIRST AID.... S A U

RECOMMENDATIONS

Code No.

For additional copies in packets of 50 send $1.00 to National Safety Council, 425 North Michigan Avenue, Chicago, Ill. 60611

Stock No. 429.73

Printed in U.S.A.

INDEX

A

Access, safe 104-105
Accident, definition of 17
Accident sequence 13-14
Accidents
  reportable. 156
  recordable 157
Administering accident prevention programs . . 54
Administration, principles of 54-57
Alarm systems 145
Analysis, hazard 93
Authority, exercise of 64-65

B

Benefits, accident prevention
  immediate 2-3
  intermediate. 3
  long range 3
Biological agents 130-131

C

Case stories 10-11
Charts 74
Chemical agents 129-130
Committee, safety
  local steering 38
  purposes. 48-49
  policies and procedures 49
  state steering 35
  types 50
Competition. 72
Cooperating agencies 51-52
Corrective action 68

D

Detroit Public Schools, accident data. 4-5
Disability
  permanent partial. 18
  permanent total 18
  temporary total 18
Disinfection 138
Documentation 73-77

E

Education, safety. 165
Education, safety, for administrators
  and supervisors. 172-174
Electrical accidents
  causes 122-123
  prevention 124-126
  results 121
Electrical safety 84-85
Electromagnetic radiation 131
Emergency action plans 142-143
Enforcement 65-66
Environment control 133-134
Equipment care and operation 83-84
Equipment placement 103
Evacuation, building 144-145
Exposures, types
  ingestion 133
  inhalation. 132
  skin contact 133

F

Face shields 138
Facility design 99-100
Fault of person. 15
Fire prevention and extinguishment. 116-121
Fires
  causes of 117-119
  classification of 119-120
  conditions for 116-117
  control of 120
Fire safety 85
First aid 86, 146
Forms 76-77
Forms, accident report. 157-158

G

Goggles, cover 136
Guard requirements 111-113
Guarding, machine 108-113
Guards, types of
  automatic. 111
  fixed 111
  interlocking 111

H

Handling, manual. 105-106

- Hazards
  - finding 68-69
  - knowledge of 68
  - remedies, applying 69
  - remedies, selecting 69
- Hazards, physical 16
- Hazards, special 104
- Health hazards
  - classification 129-132
  - control 133-134
  - types of exposures 132-133
- Helmets 137
- Housekeeping 84, 126
  - objectives of 126-127
  - practices 127-129
  - responsibilities for 127

I

- Injury types 17-18
- Incentives 69-71
- Inspections 80-81
  - checklists 151-152
  - inspectors 149-150
  - procedure 150-151
  - types 147-148
- Instruction, techniques of 81-83

L

- Legal aspects 13
- Lifting 105-106
- Lighting 101
- Listening 58

M

- Machine guarding 108
- Maintenance
  - for safety 113-114
  - preventive 114-116
  - routine 114
- Manual handling 105
- Master plans 30
- Moral aspects of accident prevention 12
- Motivation techniques 71-73
- Motives and incentives 69-71

N

- National Safety Council accident data 5
- Nip points, in-running 109
- Noise 131

O

- Organization, principles of 30-34
- Organizational structure 34
  - local organization 37-40
  - state organization 35-37
- Organizing for accident prevention 29
- Organizing, steps in
  - local 42-43
  - state 40-41

P

- Personal service facilities 102
- Personal protection 86-87
- Personal protective equipment
  - clothing 141
  - eye and face 135
  - hand, foot, and leg 139
  - head and ear 139
  - respiratory 140-141
- Physical agents 131
- Placement of equipment 103
- Pledge, safety 77
- Point-of-operation hazards 109-110
- Policies
  - characteristics 43
  - kinds 43
  - written 45
- Practices, safety 80
- Preventive action 66
- Principles of administration
  - changing conditions 54
  - communication 56
  - human factor 59
  - leadership training 58
  - policy making 62-63
  - rationale for planning 60
  - records 56
  - research 55
  - standardizing 63

- Principles of administration—*continued*
  - standards of performance 55
  - technological change 59-60
- Principles of organization
  - assignment of function 32
  - authority to perform 32
  - decentralization 32
  - excessive units 31
  - line of authority 33
  - master plan 30
  - number of individuals per supervisor 33
  - organizational structure 31
  - over-attention to detail 33
  - planning participation 30-31
  - related function 32
  - report only to one supervisor 34
  - responsibilities assigned 32
  - skills and talents utilized 33
- Problem of accident prevention 4

R

- Reciprocating motion 109
- Respiratory devices 140-141
- Responsibility
  - administrator 45-47
  - safety specialist 47-48
  - teacher 48
- Reporting, accident 152-162
- Report forms, accident 157-161
- Reports, accident 81
- Right way to accident prevention 24
- Rotating motion 108
- Rules and regulations 91-92

S

- Safety education for
  - administrators 172
  - shop students 175
  - supervisors 172
  - teachers 170-172
- Selection of tools 102-103
- Sequence of an accident 13-18
- Space allocation 100
- Speaking 57
- Specialist, safety
  - responsibilities 47-48
  - subject area, local 37-38
  - subject area, state 35-37
- Spectacles 136-137
- Standards, safety
  - local shop rules 91-92
  - regulatory 88-89
  - self-applied 90-91
- Statistics 75
- Storage of materials and tools 106-108
- Supervision 65
- Systems approach 18-27

T

- Teacher education for safety
  - Olivo 170-171
  - NAITE 171-172
- Teacher responsibilities 48
- Temperature extremes 131-132
- Traffic flow 104
- Training of students 175-178
- Training, safety 166-167
- Transmission, power 108
- Transverse motion 109

U

- Unsafe act 15-16
- U.S. Department of Labor
  - work injuries to minors 6-12
- USA Safety Standards 90
- USASI 91

V

- Ventilation 101
- Visitor's permit 77